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SLEEP HYPNOSIS DREAMS

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A Popular Exposition
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FOREIGN LANGUAGES PUBLISHING HOUSE
Moscow

TRANSLATED FROM THE RUSSIAN

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INTRODUCTION

It has been known for ages that sleep is a vital factor in human life. After a tiring day people go to bed as early as possible so as to restore their energy. A deep, sound sleep makes a person feel refreshed and vigorous, ready again for active work. When a seriously ill patient finally falls into a long and deep sleep after many restless nights this is rightly looked upon as a sign of recovery.

Sleep is spoken of in the warmest of words: it is healthy, sound, refreshing, restoring, calming, peaceful, sweet, enchanting.

Sleep that consoles and heals is the subject of many touching folk songs, and as such it is described at length in many works of fiction:

Sleep that knits up the ravelled sleeve of care,
The death of each day's life, sore labour's bath,
Balm of hurt minds, great nature's second course,
Chief nourisher in life's feast,

wrote William Shakespeare.

A poem by the great Russian poet Alexander Pushkin called "Sleep" contains the following words:

To sleep, Morpheus' precious gift, I sing,
That ye then know how one in deep and pleasant
Slumber midst silence should repose in calm.

However, although sleep, as a state to which man returns day after day, was a subject of wide discussion, and many researchers studied the problem of sleep and dreams, its nature remained inexplicable for a long time.

Various mystical conceptions prevalent in the past have proved to be particularly persistent. The sources of false ideas, of superstition and prejudice go back to antiquity.

People do not react to external stimulation and lie passive when asleep, though in their dreams they may be busily active, find themselves in far-off places, meet many other people, witness and participate in many different events. All this seemed to primitive peoples to be due to the existence of a spirit, or soul, something distinct from the body, and this led to the idea of a supernatural, unearthly world. The naïve mind of primitive man could not differentiate between dreams and reality. Many scientists—Tyler, Lubbock, Spencer, Darwin—have in their time pointed out the part played by dreams in the origin of the conception of animate nature, "animism", among primitive peoples.

Frederick Engels wrote: "From the very early times when men, still completely ignorant of the structure of their own bodies, under the stimulus of dream apparitions came to believe that their thinking and sensations were not activities of their bodies, but of a distinct soul which inhabits the body and leaves it at death—from this time men have been driven to reflect about the relation between this soul and the outside world."

In primitive man, ignorant and helpless against the forces of nature, dreams gave rise to superstition and prejudice; however, the same is true of many of our contemporaries for whom dreams and associated phenomena are also a source of superstition and prejudice, darkly veiled in religious and mystical ideas.

In certain countries various occult "sciences" such as spiritualism, astrology, animal magnetism and other false teachings have not only been retained, but have even expanded in recent years; numerous "Dream Interpreters" are published, the number of people engaged in dubious professions—chiromancy, fortune-telling, magnetism, mesmerism—increases, as do the numbers of other quacks and frauds. However, research in the diverse fields of natural science and medicine, philosophy and psychology has led to the gradual formation of a true scientific conception of sleep and associated phenomena.

The solution of this complex problem was particularly furthered by the investigations of the Russian physiologist Ivan Pavlov who forwarded a general biological and physiological interpretation of the phenomena of sleep, hypnosis and dreams, of brilliant simplicity and exhaustive depth. The inquisitive, creative mind of Man could not fathom this riddle for thousands of years.

Pavlov, true to his principle of the close connection between physiology and medicine, made another signal discovery: he revealed the importance of sleep in health and pointed out that sleep

might be used in therapeutic aims for the treatment of various disorders.

Finally, it is noteworthy that Pavlov's studies of sleep, hypnosis, and dreams, based as they were on his teachings on the higher nervous activity, dealt an undermining blow to idealism and mysticism. The scientist himself considered his works in this field exceptionally important.

"We came up against the phenomena of sleep at an early stage in our research; we were obliged to consider it, to subject it to special investigation," wrote Pavlov. N. Krasnogorsky, Pavlov's closest disciple, who also devoted many of his works to the problem of sleep, recollects that not long before his end Pavlov spoke of his wish to write a special book on sleep. It is indeed regrettable that this wish was not realised.

THE SIGNIFICANCE OF SLEEP

A change in the rhythm of vital activity is observed in all living things, not only in animals, but in plants, too. Thus the difference in plant respiration in the daytime and at night, the more powerful ascent of the nutritive juices at night. It is also known that the leaves of plants such as the mimosa and acacia fold and curl up for the night.

However, it is only in the higher animals and in man with their highly organised central nervous systems and particularly well-developed cerebral hemispheres, that a clear difference is noted between the sleeping and waking states, a distinct periodic rotation of these states.

There are many variations of normal sleep. Observations of animals have shown great diversity in the rotation of sleep and wakefulness. The peculiarities of the rhythm of sleep and waking in different species of animals is due to adaptation to conditions of life developed in the evolutionary process. Sleep is differentiated into two types: one-phase sleep, when the animal sleeps without break once in 24 hours, and multi-phase sleep, when sleep and vigil alternate many times in the course of 24 hours. Multi-phase sleep is observed in many domestic animals. A well-known picture is that of a kitten playing with a ball of wool and then curling up and purring in its sleep, or that of a dog now running around and barking, now peacefully asleep in the sun on a warm day.

Most animals are active in the daytime and sleep at night; however, some animals are active at night and sleep in the daytime, as, for instance, the owl and other so-called night birds.

In man the rhythm of activity and sleep is influenced by age, occupation and conditions of life. Multi-phase sleep is characteristic of very young children; infants sleep several times a day. In adults one-phase night sleep is commonly observed. However, in certain cases a person's professional occupation may necessitate the replacement of night sleep by several periods of sleep in the daytime (railroad employees, medical workers).

Besides one- and multi-phase sleep within 24 hours, there also exists another type of sleep, "seasonal" dormancy—prolonged torpidity during a certain time of the year, e.g., the hibernation of the hedgehog, bear, marmot, badger and dormouse, famed for its ability to sleep. A similar state of dormancy, estivation, is observed in certain tropical animals in the summer when the insufferable heat makes conditions particularly unfavourable. "Seasonal" dormancy—hibernation and estivation in animals—differs from natural periodic daily sleep both in duration and in the quality of changes that take place in the body. For instance, it is known that many animals lose the faculty of maintaining a constant body temperature during prolonged winter or summer torpidity; their temperature becomes the same as that of the air in their lair or burrow.

Deprivation of food is endured much easier than deprivation of sleep; without sleep both man and animals succumb sooner than in conditions of complete starvation. M. Manasseina, a pre-revolutionary Russian scientist, conducted a number of extremely illustrative experiments: puppies deprived of sleep succumbed within four to five days, adult dogs survived for 18-20 days. N. Fyodorov and A. Sokolovskaya recently performed a series of experiments in which the dogs were not allowed to sleep for eight days by means of various irritants; however, not-

withstanding all interference, they did fall asleep on the eighth day, while two of the animals succumbed.

Sleep should be distinguished from similar states that are defined by the words "syncope" (fainting or swooning), "shock", "coma".

What is common in these states with sleep is that the subject is inaccessible to external impressions and incapable of conscious activity. But these are morbid conditions caused by severe derangement of brain activity. Fainting fits, or syncope, are due to a sudden development of cerebral anemia, shock is a grave generalised disturbance of the bodily functions associated with respiratory and circulatory disfunction and decrease in blood pressure, coma is usually defined as deep cerebral intoxication.

But periodic sleep is a normal, healthy, natural state of the brain. People awake from sleep, even from the deepest, independently, while a person in syncope, shock or coma is only brought to his senses by special treatment that removes the cause of these morbid conditions. Moreover, natural sleep should be distinguished from sleep evoked by any agents that influence the human body and nervous system. For instance, during sleep induced by narcotics and anesthetics (chloroform, ether, etc.) the subject is insensible to pain, thus surgery performed on him is painless. Another type of artificial sleep is electronarcosis evoked by the effect a certain type of electric current produces on the nervous system. Various types of "artificial" sleep either approach natural sleep or are similar to the above-described sleep-like morbid conditions.

CHANGES OCCURRING IN THE BODY DURING SLEEP

During the waking hours a human being reacts keenly to his environment: his eyes observe minute changes in the surroundings, his ears hear the slightest rustle, his body feels the most delicate touch, and even the slightest

changes in temperature. By the aid of the muscular-joint sense we perceive the position of our bodies in space and retain our equilibrium.

In the waking state the active, clear and fine perception of all changes occurring in the environment is indivisible from the reaction to such changes. In the waking period the central nervous system is in constant activity, even if no external manifestations of this activity are noticeable. For instance, when a person is sitting quietly in an easy chair listening to music, or hearing a funny story it would seem that he is displaying no physical or mental exertion; however his central nervous system is still functioning actively. In this seemingly passive state the external organs of sense—the eyes, ears, skin—and the nerve endings in the muscles, tendons and all the visceral organs are continuously transmitting streams of diverse signals into the central nervous system, informing it of what is taking place in the external environment and in the body itself. The central nervous system receives all these signals and promptly reacts by sending corresponding impulses to the different executive organs, thus controlling and co-ordinating their work, and adapting the reactions of the body to the continuously changing environment. Hence the central nervous system is in a state of constant activity.

A sleeping individual presents quite another picture. His perceptions, feelings and reaction to external stimuli are either sharply inhibited or, depending on the depth of his slumber, health, age, etc., disappear almost completely. All manner of low sounds, light touches or stimulation of other sensory organs, if not strong enough to awaken the sleeper, are either attended by no sensations, or call forth only very weak, vague ones. Such stimulation either evokes no motor reflexes at all, or causes only very slight ones. Thus the activity of the central nervous system undergoes a sharp change during sleep. It is a known fact that one of the symptoms of the approach of sleep is the relaxation of almost all the muscles. This

relaxation begins with the muscles of the neck, when a person begins nodding, his head falling either forward or sideways. As sleep becomes deeper the other muscles of the body relax, except for certain muscles the tension of which is essential for the proper functioning of the body in sleep. An example of this is the orbicular muscle of the eye: its contraction shuts the eye tightly, thus protecting it against light, contamination, and injury. Tension is also retained in the muscles of the urinary bladder and rectum that "lock" these hollow organs and thus exclude involuntary passage of their contents during sleep. The activities of all the other organs and systems of the body also alter during sleep. The heartbeats are weaker and slower, pauses between them longer. Blood pressure falls by 20 to 25 mm mercury. The blood stream flows slower, particularly in such vital organs as the brain, liver, kidneys. The vessels in the skin dilate, the amount of blood in them increases, and the skin feels warmer, although the bodily temperature in general falls. Breathing becomes slower, deeper, evener. Sometimes it grows noisy owing to the loosening of the soft palate, the edge of which hangs freely and vibrates during inhalation and exhalation. Oxidation processes and metabolism decrease. During sleep the kidneys secrete 2 to 4 times less urine. The activity of a number of glands also decreases, particularly of the glands in the facial area. This explains the cause of the disappearance of rhinitis in the morning after a good night's sleep, the dryness that may be present in the mouth, the burning sensation in the eyelids—"sand in the eyes". It is commonly known that little children rub their eyes with their fists when falling asleep or waking up; they do this to increase the secretion of the tear glands that moisten the eyes. At the same time the activity of the glands of the digestive organs, liver, and pancreas is but slightly altered during sleep, while the sweat glands even increase their activity. Often the faces of sleeping children are covered with tiny drops of perspiration.

The vital activity of the organism as a whole during sleep may be characterised as being aimed at providing the prevalence of income over expenditure in the processes of interchange of substances and energy that proceed continuously between the organism and its environment. The lowering of temperature observed during sleep, changes in metabolic processes and oxygen supply delivered to the tissues, as well as a slackening in the activity of the circulatory organs, relaxation of the musculature and complete muscular repose—all this undoubtedly helps to restore and replenish the material resources of the body expended in the active period during the waking hours.

As we shall see further, such restoration processes are of especial importance for the central nervous system, particularly for its highest section, the cortex of the cerebral hemispheres. To comprehend what takes place during sleep in the nervous system it is important to understand the following circumstances.

E. Asratyan, a leading Soviet physiologist and a pupil of Ivan Pavlov, points out that the highly active cells of the central nervous system are very tender and fragile. While the muscular and glandular cells have local resources of nutrition the cells of the central nervous system are almost totally deprived of such resources. However, the metabolic processes in them are very vigorous. Nerve cells require several dozen times more oxygen than do muscular or glandular cells. The same is true of requirements in glucose, that particular kind of sugar that is the essential food of all the cells in our body and the source of their energy.

The long evolutionary process of development of the animal world has evolved a number of complex adaptational features the aggregate of which creates particularly favourable conditions for the viability and work of the delicate, vigorous, and extremely important nerve cells. The extensive network of blood vessels in the brain provides its cells with necessary nutrition and oxygen, and is

also the best route for the timely removal of waste products. It is known, for instance, that the dense 110-kilometre-long channel of cerebral blood vessels conveys one litre of blood per minute, that the blood in the internal carotid that delivers blood to the brain flows 150 times faster than in the external carotid that delivers blood to all the rest of the body. Moreover, during the waking hours the intensively working parts of the brain rest alternately if no extraordinary circumstances arise.

Notwithstanding this the nervous system is the first to weaken and become fatigued during prolonged intervals without sleep, and it requires proper rest before any of the other systems of the organism do.

That is why in speaking of sleep as a phenomenon restoring work capability we stress the extreme importance of sleep for the central nervous system, particularly for its highest section, the cerebral cortex.

CRITICISM OF VARIOUS THEORIES OF SLEEP

Numerous scientific theories and hypotheses have been proposed to explain the causes of sleep. Most of them are too schematic and one-sided to offer more than a historical interest at present. However, certain of them, particularly those that are still widespread in our days, offer some points of interest, and it is therefore expedient to review them critically.

The Vascular Theory of Sleep. The scientific proponents of this theory explained the onset of sleep by alterations in cerebral circulation. They considered that sleep was evoked by a decrease in the inflow of blood to the brain. On the other hand, other authors assumed that sleep was caused by an intensification of the supply of blood to the brain. To prove the role of changes in cerebral blood circulation Angelo Mosso, an Italian scientist, constructed a special "scale-bed": the subject of observation was placed

in this bed in order to establish which part of him becomes heavier (head or feet) when he slept. Mosso considered that this was a good criterion for judging whether inflow or outflow of blood was predominant in the sleeping brain. According to his results the feet become heavier when a person is falling asleep, when he is awakening the head is heavier. From this he concluded that the onset of sleep was connected with cerebral anemia, a decrease in the inflow of blood to the brain. However, the investigations of a German researcher, Ernst Weber, showed that Mosso offered a wrong interpretation of the facts he had observed. The overbalance of the foot of the bed is not due to an outflow of blood from the brain, but to a redistribution of the blood between the viscera and the extremities during sleep.

Let us dwell briefly on other facts that seemingly confirm the dependence of the onset of sleep in man on an alteration in cerebral blood circulation. Thus it is known that when the large blood vessels of the neck (through which blood is delivered to the brain) are compressed a state of unconsciousness resembling sleep is instantly evoked. In Russian these great arteries that deliver blood to the brain, the carotids, are even called the "sleepy" arteries. On the other hand, it is known that in cases of brain tumours, cerebral hemorrhages and other conditions associated with a surplus delivery of blood to the brain unconsciousness is also observed, the patient falling into a sleep-like state. We speak of a "sleep-like" state, as the weakness and error of the "vascular" theories of the origin of sleep lie in the fact that the proponents of these theories confuse normal sleep with the morbid stupor (syncope, shock and coma) mentioned above. Although decrease in blood pressure and slowing down of the flow of blood in the brain are observed during sleep, such changes must be looked upon as being associated with sleep, and not the reason of sleep.

The Chemical Theory of Sleep. All the adherents of this theory, notwithstanding their various standpoints on individual points, agree that sleep of both man and animals is a result of the intoxication of the brain with various toxic products of metabolism accumulated in the organism in its waking hours.

The "chemical" theory of sleep has been substantiated with particular thoroughness by the French scientists Legendre and Piéron. To prove the truth of their scientific hypothesis these researchers injected just-awakened well-rested dogs with serum from the blood of dogs that had not been allowed to sleep for many hours. The injected animals went to sleep immediately. The same result was obtained with the spinal fluid of dogs that had not slept for ten days, when it was injected into the cerebral ventricles of well-rested, active dogs. On the basis of these experiments Legendre and Piéron concluded that sleep is produced by intoxication of the brain with "sleep toxins" (hypnotoxins) that accumulate in the blood and cerebrospinal fluid of animals. Other researchers later conducted similar experiments, with similar results.

However, a number of indisputable facts have proved that this theory, too, is wrong. First of all, in order to prevent the dogs from falling asleep Legendre and Piéron made them work heavily for many days, thus creating a peculiar state of fatigue and complete exhaustion that has nothing in common with the state that precedes normal sleep. Secondly, this theory is opposed by the fact of the sudden onset of normal sleep and just as sudden awakening. If the reason of sleep were "self-intoxication" then sleep should be produced very gradually as the so-called hypnotoxins accumulate in the blood, and a person should also awaken gradually as the toxins are eliminated from the body. Another contradiction to the "chemical theory of sleep" is the well-known fact that sometimes it is sufficient for a person to sleep for only a few minutes to become refreshed and active and stop feeling drowsy.

that controls sleep. The followers of this theory reason thus: if sleep is an important manifestation of vital activity then there must be a special centre in the brain for its regulation, as there exist nervous centres for digestion, respiration, and for other important functions of the body; therefore there must also exist a specific nervous centre for sleep, they say.

The overwhelming majority of adherents of this theory consider that the centre of sleep is located under the cortex of the cerebral hemispheres, in the subcortical areas. The argumentations of these scientists are based on two groups of facts.

The first group includes clinical observations of various patients afflicted by deep disorders of sleep. Thus, for instance, autopsies performed on bodies of patients who had succumbed to encephalitis (a disease that is characterised, among other symptoms, by prolonged sleep lasting many days) by the Austrian researcher Economo showed that the morbid changes in the brains of these patients were located in sections near the base of the brain. Proceeding from this it was concluded that the "sleep centre" was located namely in this area of the brain, and that the morbid drowsiness of encephalitis patients was caused by the stimulation of this centre.

Another group of facts was obtained on the basis of experiments conducted by the Swiss physiologist Leo Hess. He bored openings in the skulls of the experimental animals and through them passed special electrodes into the brain, to terminate in a given area. The electrodes were two fine wires coated with insulating varnish except for their ends. An electric current sent through the electrodes affected only that area of the brain in which the electrodes terminated. Leaving the electrodes in the brain and fastening their outer ends to the edges of the aperture in the skull bones, Hess sutured the wounds. After several days, when the animals had recovered from the operation, he performed his experiments, which consisted of running an

electric current through electrodes terminating in various areas of the brain. It was found that when the electrodes terminated closer to the base of the brain, in the region of the hypothalamus, the animals immediately fell into a deep sleep. When the current was passed through electrodes placed in other parts of the brain no sleep was evoked. Similar experiments, with approximately the same results, were performed by other researchers, among them the Soviet scientist A. Tonkikh.

The "theory of a subcortical centre of sleep" was objected to by Ivan Pavlov; he put forth another interpretation of the facts on which this theory is based. Pavlov rejected the idea of there being a "sleep centre" in the brain. He considered that the abnormally protracted sleep of encephalitis patients was not due to the stimulation of an "imaginary, fantastic" sleep centre in the hypothalamic area, but was caused by lesions in this section of the brain that blocked the conduction of stimulation to the cerebral cortex from the viscera. And namely these stimulations are the most important factors in maintaining the waking state. Pavlov held this morbid condition to be analogous to the abnormal sleep produced in dogs by one of his pupils, V. Galkin; the latter severed the nerves connecting the brain with the organs of smell, hearing and vision, thus sharply decreasing the penetration of external stimuli. Pavlov also criticised the conclusions drawn from the experiments of Hess. He pointed out that during these experiments no "special group of nerve cells regulating sleep" was stimulated, but only the conductors of nerve impulses to the cerebral cortex. In this manner the cortex receives the weak rhythmic stimuli caused by the electric current in the lower layers of the brain. Conditions conducive to sleep are thus created, similar to conditions arising from weak rhythmic external stimuli. The fact that Pavlov rejected the existence of a special "sleep centre" in the subcortical area does not at all mean that he attached no importance in the production of sleep to this

section of the brain. It will be seen lower, when Pavlov's views on the physiological nature of sleep are set forth, that he acknowledged both the production of sleep "from above", when somnolent inhibition irradiates from the cerebral cortex, and "from below", when this inhibition arises in the subcortical sections of the brain.

The sleep of animals with a weakly developed cerebral cortex, of animals in whom the cortex has been removed surgically, and of infants during the first days and weeks of life, when the cerebral cortex is only beginning to function—all these types of sleep are factors confirming the participation of the subcortical sections of the brain, the so-called brain stem, in the rotation of the waking and dormant periods.

Investigations made after Pavlov's death by leading electrophysiologists (Magoun, Moruzzi, and other investigators) confirmed Pavlov's hypothesis of the absence of any special "sleep centre" in the subcortical area of the brain stem. The works of these scientists revealed the complex relations existing between these sections of the brain and the cerebral cortex. They showed that there exist special nerve formations in the brain stem, the so-called "reticular substance", highly important in transmitting excitation to the cerebral cortex. They also established that the inhibition or blocking of these impulses produces sleep. At the same time the role of the cerebral cortex in the origin of this inhibition or blocking of impulses transmitted from the "reticular substance" to the cortex was also proved.

Each of the theories sets forth only one sleep-inducing factor, says E. Asratyan, thus simplifying the extremely complex physiological phenomenon of sleep. He states that even the most substantiated and widespread theories are aimed at answering only one question, namely: what produces sleep or what factors condition its onset. One theory stresses the changes occurring in blood circulation, another points out the excitation evoked in a specific

centre, a third dwells on arrest of impulses (i.e., excitation) sent by the muscles, etc. But not a single one of these theories answers the question of what sleep is, what principle underlies it. However, a theory can only be called scientific when it is not limited to a simple description and classification of phenomena, to a listing of favourable and unfavourable factors, but when it divulges the nature of these phenomena.

If the above theories be considered from such a viewpoint, it becomes clear that not one of them can be considered as being truly scientific, as none of them strives for a deep insight into the nature of sleep, not one attempts to disclose its physiological nature.

The strictly substantiated theory of sleep created by Pavlov is aimed both at clarifying the most characteristic features of sleep and at gaining a more thorough understanding of the causes producing it; it also explains its physiological nature. And if we add to this that on the basis of his theory Pavlov threw light on many complex problems connected with the onset, nature and treatment of a number of nervous and mental diseases then we may confidently affirm that his theory has expanded into a leading teaching on sleep.

PAVLOV ON SLEEP

To obtain a correct and comprehensive understanding of the views of Ivan Pavlov on the nature of sleep it is necessary to dwell, at least slightly, on his teachings on the higher nervous activity. Here Pavlov proceeded from the conception of reflexes as being the basic acts of the nervous system. According to Pavlov's definition, a reflex is the regular reaction of the organism to an external stimulation realised by means of the nervous system. To illustrate this let us suppose that food or acid has been conveyed into a dog's mouth. The dog immediately reacts

by beginning to chew the food or spitting out the acid. In both cases saliva is secreted, but its quantity and quality depend on the substance in the dog's mouth. By what is this selective secretion conditioned?

There are numerous endings of the sensory taste nerves in the mucous membrane of the mouth and tongue. The food or acid irritate these nerve endings, evoking excitation that is conducted along the centripetal nerves to the salivary centre in the medulla. From thence the excitation runs along the centrifugal nerves to the salivary glands and causes secretion of saliva.

Before Pavlov the conception "reflex" was employed by scientists in analysing descriptions of elementary reactions of the animal organism to external stimuli. Reflex activity was attributed only to the lower sections of the animal's nervous system (the spinal cord, medulla oblongata and brain stem). More complex behaviour patterns were interpreted as being subjective, psychological. If a dog secreted saliva not only while ingesting food, but at its sight or odour, or merely upon hearing the steps of the person who usually fed it, then researchers explained the behaviour of the dog by means of purely psychological conceptions: "the dog guessed", "understood", they would say, "it has conceived the idea of food", "a will to eat has appeared". Pavlov considered this kind of explanation to be erroneous.

According to Pavlov, the physiologist had been following a wrong path in studying cerebral activity, as he "yielded to the common habit of regarding the animal's activity as analogous to his own and of explaining it by the same intrinsic causes which he feels and recognises in himself".

Pavlov confidently followed the course of objective investigation of cerebral activity, proving that even the most complex behaviour patterns in animals are based on reflex nervous activity. Pavlov's outstanding contribution to science is his discovery of a new and more complex

class of reflexes, the appearance and existence of which depend on many conditions, which he therefore named "conditioned" reflexes.

Simple, or, according to Pavlov, "unconditioned", reflexes are inherent in animals at birth; they are manifested always and in all conditions in one and the same form, and are observed in all representatives of the given species of animal. The nerve route for these reflexes already exists in the animal at birth, in the subcortical areas of its brain. Conditioned reflexes are not inborn; they are acquired by the animal during life. Such reflexes are based on newly-formed nerve connections, and not on ready-made ones. However, these reflexes are not permanent, their nature is only temporary. Their nerve path passes through the cortex of the cerebral hemispheres. To form a conditioned reflex it is necessary for some hitherto neutral stimulus to coincide several times with a stimulus that evokes an unconditioned reflex in the animal. In other words, a conditioned reflex is formed on the basis of an unconditioned one. The following is an example. As was mentioned above, the intake of food calls forth an unconditioned food reflex in dogs, the secretion of saliva by the salivary glands. Supposing that before taking food the dog was subjected to a certain stimulation, such as the turning on of an electric light. If such a combination of stimuli is repeated several times, then the stimulus that previously played absolutely no part in salivary secretion (the electric light) begins to evoke a flow of saliva by itself, i.e., assumes a conditioned reflex action.

Why does the lighting of a lamp coinciding several times with feeding begin to evoke a food reflex in the dog? What is the mechanism of such a conditioned food reflex? Pavlov gives the following answer to these questions: during the reiterated coincidences of the action of food and light on the canine organism two sites of excitation appear in the dog's brain. One of these sites is in the optic centre of the brain, the other in its food centre. Gradually

a new nerve path is laid between these two sites. A "short circuit" is formed between the simultaneously excited cerebral centres.

In the process of evolution the higher animals acquired the faculty of forming new, complex and at the same time flexible, conditioned reflex nerve links with their environment; this made them more adaptable to the diverse, constantly changing external conditions. It is one thing when an animal is capable of reacting in only one specific manner to the direct action of an external factor that is highly important for this animal from a biological standpoint, and quite another thing when the animal acquires the faculty of reacting in a specific manner to stimulations that are only signals reporting the presence of important phenomena in the animal's surroundings, for instance, of a threat to his life. A vivid example of this role of the conditioned reflexes is given by Pavlov himself; he describes how a small weak animal protects itself against strong carnivorous beasts. The small animal would inevitably perish if it started to defend itself only at the moment the enemy overtook it, when the beast had already sunk its fangs into its prey. However, thanks to its conditioned reflexes, the small animal can run away and hide in a safe spot as soon as it sees the still distant beast.

It is the appearance in animals of the faculty of receiving signals that significantly increases their resistance in the battle of life.... According to Academician Pavlov, "... the fundamental and most general activity of the cerebral hemispheres is signalling, the number of signals being infinite and the signalisation variable". Noting a number of common features in the conditioned reflex activity of man and animals, Pavlov marked the deep qualitative distinctions of the higher nervous activity in man.

In animals the external stimuli (the signals) are evoked by various objects and phenomena in the outer world that directly affect the sense organs (the ears, eyes, etc.) and other receiving apparatus (receptors) in the nervous

system. Man is another matter. During the process of the development of society and of oral communication among human beings man has developed a new faculty peculiar to him alone—that of receiving signals in the form of words, conditioned stimuli that replace the objects or external phenomena defined by the given word.

In characterising the peculiarities of the higher nervous activity of man Pavlov wrote: "When the developing animal world reached the stage of man, an extremely important addition was made to the mechanisms of the nervous activity. In the animal reality is signalised almost exclusively by stimulations and by the traces they leave in the cerebral hemispheres, which come directly to the special cells of the visual, auditory or other receptors of the organism. This is what we, too, possess as impressions, sensations and notions of the world around us, both the natural and the social—with the exception of words heard or seen. This is the first system of signals of reality common to man and animals. But speech constitutes a second signal system which is peculiarly ours, being the signal of the first signals. On the one hand, numerous speech stimulations have removed us from reality, and we must always remember this in order not to distort our attitude to reality. On the other hand, it is precisely speech which has made us human. . . ."

Pavlov's words may be illustrated by one example. Let us compare the digestive reflex activity of man and of dogs, see what evokes food reactions in them, what are the signals for these reactions. Let us suppose that a man and a dog both become hungry and are taking food; the master is sitting at a properly set table, while his dog is feeding from a dish in a corner. We shall not consider the difference in the food itself, in its preparation, or the conditions and surroundings in which it is taken; it will then be seen that what the dog and master have in common is the secretion of various digestive juices on the basis of *unconditioned reflex activity of the nervous system*. Thus,

in general, the digestive juices will be secreted by both man and dog on the basis of a common neural mechanism if, when they are hungry, they see in a shop-window various foods, or smell food that is being prepared in the kitchen. This neural mechanism is already a *conditioned reflex activity* in which the first signal system common to man and animals participates. The secretion of digestive juices is evoked by the sight and smell of food received by the optical and olfactory organs of both man and dog. Now let us assume that the hungry man, walking along a street with his hungry dog, meets an acquaintance and stops for a chat. What happens if this acquaintance begins a story, relishing all the details, of the wonderful supper he had last night? How do the hungry man and his hungry dog react to this story? It is clear that only the man will evince a food response to the story, that only he will become still hungrier, and will secrete digestive juices—his "mouth will water". The dog, standing nearby, will not react in any way to the talk. The food signals, being presented in the form of speech, call forth no food reflex in the dog. Word signals, as signals of signals, do not reach the food centres in the dog's brain, as dogs, in distinction from man, possess no second signal system.

Developing his ideas on the second signal system, Pavlov emphasised that this system is formed on the basis of the first system, and also that both of these signal systems in man act together, in indivisible unity. As we have already pointed out, the activity of the first signal system is directly connected with the perception of the surrounding reality by means of the sense organs. The activity of the second signal system is connected with man's faculty of communicating with other people by means of speech and with his faculty of thinking in words, a mental activity of a more general and abstract nature.

But is it then possible to think of separate and independently existing perception and thinking! Can there then be perception without intelligent comprehension of

what is being perceived or thought without any relation to perception that is its source, that supplies food for thought! It is also necessary to bear in mind that the thoughts of man and his perceptions are indivisibly connected with social conditions, that they are defined by the social experience of man, experience that is acquired in the process of education and intercourse with other people.

Studying the higher nervous activity of man and animals, Pavlov based himself on the clauses previously established by I. Sechenov and N. Vvedensky who declared that it was characteristic of the nervous system to develop two contradictory processes, excitation and inhibition, processes indivisibly connected and complementing each other. "Our whole life," says Pavlov, "is a continuous interaction of these two processes.... These processes are inseparable, they are always present not only in the nerve cell but in each nerve fibre."

Excitation conditions the work of the nerve centres and the organs these centres govern, while inhibition, on the contrary, discontinues or weakens the activity of these centres and organs when required. The uninterrupted and co-ordinated activity of the numerous and diverse organs require the presence of both processes.

For clarification of Pavlov's views on the physiological nature of sleep it is particularly important to become acquainted with his conception of the process of inhibition.

Pavlov differentiated two basic types of inhibition:

1) *external, unconditioned inhibition,* and

2) *internal, conditioned inhibition.*

To gain a better understanding of the specificities of each of these types of inhibition we shall cite several examples. Let us begin with unconditioned inhibition, taking an ordinary experiment in which a conditioned salivary reflex to food is formed when a bell rings. For the formation of such a reflex it is necessary that the

ringing of the bell, a stimulus to which the dog was previously indifferent, be combined several times with feeding. After several experiments the bell becomes a food signal, and the dog begins secreting saliva as soon as it hears the bell, as if it were given food. Now let us suppose that during experiments with a dog in whom a stable conditioned reflex to a bell has been formed a sudden strong and strange signal is introduced—a piercing whistle. The dog will respond to this new stimulus with the so-called orientation reflex, turning its head toward the source of irritation, taking a defensive or offensive attitude, jumping and barking. Salivary secretion in response to the ringing of the bell will be arrested, as the conditioned reflex is inhibited by the sudden strong excitant. This is a case of external unconditioned inhibition. The most characteristic feature of this type of inhibition is that it originates either in the external surroundings or in another excited area of the brain, and is based on the addition of an external agent to the conditioned stimulus. External unconditioned inhibition is of an inborn nature: its appearance, according to Pavlov, is an instance of negative induction. What he meant by negative induction was a manifestation of nervous activity during which the process of excitation in the brain evoked, conditioned, or "induced", subsequently or adjacently, the opposite process of inhibition.

Internal conditioned inhibition was Pavlov's designation of inhibition that arises directly in the excited area of the brain, when the conditioned stimulus is not supported regularly by an unconditioned one, or when the support is retarded.

What is the nature of internal conditioned inhibition? Take a dog in which a conditioned salivary reflex to the ringing of a bell has been formed; during many subsequent experiments the conditioned reflex is not supported by the unconditioned reflex: the bell rings, but the animal receives no food. It is clear that in this case the bell is

no longer a food signal; as a result less and less saliva is secreted in response to the bell, until its ringing evokes no salivary reflex at all. The reflex has been "extinguished". This type of internal inhibition that is the result of the conditioned reflex not being supported by an unconditioned one was called "*extinguishing*" inhibition by Pavlov.

There are also other types of internal inhibition, as, for instance, "retarding" inhibition, "differential" inhibition.

The peculiarities of the "*retarding*" inhibition are: in ordinary experiments of conditioned reflex formation the conditioned stimulus acts for no longer than 20-30 seconds before the unconditioned stimulus is added. In these cases the conditioned reflex appears immediately, as soon as the conditioned external stimulus is brought into play. Let us assume such conditions of an experiment when the unconditioned stimulus is added to the conditioned somewhat later, after 2-3 minutes. If, for instance, the conditioned stimulus for salivary secretion is a bell, then the dog is given its food only when the bell has been ringing for over two minutes. At the beginning, as during ordinary experiments, secretion is evoked immediately, as soon as the bell begins ringing; however, the flow of saliva is gradually delayed to the second or third minute, i.e., to the time when the animal takes its food. The reflex is retarded. Such a delay in the appearance of the reflex is the result of that form of internal inhibition that Pavlov called "retarding internal inhibition".

"*Differential*" inhibition may easily be understood from the following example. Let us take a dog in which a stable conditioned food reflex has been formed in response to some musical sound, for instance the tone "do". Later the experimenter adds another musical tone, let us say "la". The tone "do" will be supported by food, while no food will be given with "la". At first the dog will respond to both tones with salivary secretion and a corresponding motor reaction. In other words, the tone "la",

as well as the tone "do" becomes a conditioned stimulus evoking a food reflex. But if in subsequent experiments the tone "do" is always supported by food, while "la" never is, then the dog's reflex to "la" gradually weakens, and finally disappears altogether. Upon hearing the tone "la" the dog does not move, and if it does, then chiefly to turn its head away from its dish. Not a drop of saliva is secreted. But the reflex to the tone "do" is retained in full. Thus, the result of not supporting a conditioned reflex to one of two stimuli employed is that the positive conditioned significance of this stimulus seems to disappear. However, as in our previous examples, the reflex is not destroyed altogether, it is only inhibited by the type of inhibition that Pavlov called "differential" inhibition.

What proofs are there that the tone "la" evokes inhibition in the cerebral cortex of the dog? Here is one proof: if this tone "la" is later combined with any other conditioned stimulus the conditioned reflexes in response to these stimuli deteriorate sharply. For instance, a conditioned reflex has been formed in a dog in response to the scratching of its skin, or to the sound of a metronome, to an electric light; all these stimuli have always evoked a positive response individually. Now if any one of them is combined with the sounding of the tone "la" their effect is greatly lowered. It is clear that this weakening of a conditioned reflex is evoked by no neutral process, but by an active process in the nervous system, a process opposite to excitation, that is, by inhibition.

This example clearly illustrates the important role played by inhibition in the conditioned reflex activity of animals. A stimulus, a musical tone ("la") no longer signalises the ingestion of food, and the conditioned reflex to this stimulus is removed by the process of inhibition.

During the life of an animal its brain is subjected to an enormous number of the most diverse and gradually changing excitations in the surroundings that often com-

pete with each other. Proper behaviour of the animal, ensuring equilibrium with the environment, would be impossible if the organism (by means of the nervous system) could not react to some stimuli and arrest responses to others. Any kind of animal activity is based on the combination of activating and inhibiting mechanisms; according to Pavlov the cerebral cortex is a most complex and mobile mosaic of excited and inhibited points at every given point of time.

But the significance of inhibition is not exhausted by this co-ordinating activity, by participation in the adaptational activity of the cerebral cortex. An extremely important discovery was Pavlov's revelation of the peculiar protective, or defensive, role of inhibition, of its restorative-curative significance for the nerve cells of the brain.

There is a certain limit to the working capacity of the nerve cells, to their endurance, to the limit of harmless tension the exceeding of which may lead to extreme exhaustion, or even destruction. Inhibition brings the nerve cells relaxation and rest, it provides conditions for recuperation of their power and energy.

Pavlov found the cells of the cerebral hemispheres to be highly sensitive to the slightest changes in environment; he pointed out that they must be carefully guarded against overexertion and that inhibition was their protective agent. Pavlov looked upon transmarginal, protective inhibition as belonging to the group of external unconditioned inhibitions.

And now let us turn to the investigations of sleep made in Pavlov's laboratory.

Sleep was a phenomenon Pavlov and his associates encountered in their very first steps in the investigation of conditioned reflexes. The sudden drowsiness and sleep that appeared in the experimental animals interfered with experiments, or made their conduction extremely difficult. Therefore from the very beginning the attention of Pavlov and his associates was focussed chiefly on overcoming

drowsiness and sleep. It was only in later stages of these studies that the Pavlov laboratory became interested in sleep as such. From being an obstacle in experimental work sleep gradually became the object of deep experimental study. Systematic investigations of the physiological nature of sleep in Pavlov's laboratory were commenced in 1910. While attempting to evoke conditioned reflexes by different temperature stimuli Pavlov's associates O. Solomonov and A. Shishlo found that not only were no conditioned reflexes formed in response to a number of such stimuli, but that all reflex activity in general was stopped and the animal went to sleep. On the basis of the experiments of Solomonov and Shishlo Pavlov stressed the reflex mechanism of the onset of sleep, the existence of a "passive soporific reflex". It was during that same year of 1910 that Pavlov formulated his principal clause on the physiological nature of sleep, noting that ordinary sleep is the inhibition or restraint of the entire activity of the higher section of the brain.

Subsequently, while conditioning dogs to various types of internal inhibition, Pavlov established the natural law governing the transition of internal inhibition into sleep, and vice versa, sleep into inhibition. He succeeded in investigating how inhibition, gradually spreading over larger and larger areas of the cerebral cortex, finally turns into sleep.

In a paper on sleep addressed to a conference of neuropathologists and psychiatrists in Leningrad in 1935 Pavlov figuratively described this diffusion of the inhibition process in the brain of one of his experimental dogs, from the very beginning to the onset of deep sleep.

At the beginning of the experiment inhibition was restricted to the area of the cerebral cortex in which the nerve centres controlling the movement of the tongue are located. Then the process spread to the nerve centres governing movement of the jaws. At this phase the dog

could not chew, food dropped out of its mouth. Later the inhibition had already spread to the centres regulating the movement of the muscles of the neck, and the dog could not turn its head toward food without turning its whole body. Still later inhibition affected the movements of the body, the entire skeletal musculature became flabby, and the dog fell asleep hanging in its straps. "When you observe this development," said Pavlov, "you can hardly doubt that inhibition and sleep are one and the same process."

Thus we have seen that sleep may develop both on the basis of unconditioned external inhibition, and of conditioned internal inhibition. Pavlov emphasised this point in a talk he had in 1935 with his pupil F. Maiorov in which they discussed the place of sleep inhibition in a proposed classification of types of inhibition. It is noteworthy that Pavlov stressed the diffused nature of the inhibition of sleep, in distinction from inhibition during the waking state; the latter is of an extremely localised nature.

According to Pavlov inhibition is a partial, fragmentary, strictly localised sleep confined within definite boundaries under the influence of the opposing process, excitation; sleep, on the contrary, is an inhibition which has spread over a great section of the cerebrum, over the entire hemispheres, and even into the lower lying midbrain.

As inhibition is for the individual nerve cells, so is sleep, held Pavlov, a protective biological act for the nervous system as a whole, protecting the brain against overexcitation and associated exhaustion.

Thus, to sum up Pavlov's interpretation of the physiological nature of sleep, two basic clauses may be set forth:

1) *Sleep is diffused inhibition that has spread throughout the highest sections of the brain.*

2) *Sleep is a protective and recuperative factor in brain activity.*

For ages hypnosis has been looked upon as some supernatural state, and as such it was always veiled in mystery; it was considered to be some peculiar form of sleep in which the sleeper retained a mysterious bond with the hypnotiser, responding to his suggestions, obeying his will. However, the practical utilisation of hypnosis dates back to earliest times in the history of mankind.

Hypnotism was known and employed by the priests in the temples of ancient Egypt, India and Greece. It is indeed an interesting fact that the temples housed certain individuals who were particularly susceptible to hypnosis, so-called mediums, and that the priests interpreted the answers these mediums gave while in a hypnotic state as being oracular prophecies prompted by the gods.

In the Middle Ages ceremonies of mystic doctoring by means of hypnosis were performed by monks and overlords, while the famous physicians and astrologers of those times, Paracelsus and van Helmont, explained hypnosis as being the result of a power similar to that of a magnet that attracts iron from a distance. This force was allegedly possessed by certain people, magnetisers, who, thanks to it, obtained unlimited power over other persons. Thus was born the legend of "animal magnetism." The false idea of animal magnetism was adroitly (and widely) used at the close of the 18th century by the Austrian physician Franz Anton Mesmer. The latter sent his subjects into a hypnotic sleep by so-called "passes"—rhythmic, slow motions with the hands at some short distance from the subject's body, directed from head to feet. Mesmer "interpreted" the success of his "passes" as being the result of a specific "fluid" possessing magnetic power and flowing from the magnetiser's fingers. The practical "curative" activities of Mesmer attained unheard-of popularity. Throngs of credulous people seeking cures for their various ailments applied to Mesmer.

However, in 1774 a special medical committee assigned by the French government exposed this "healer" for what he was—a quack.

In 1815 Abbot Faria of Portugal vehemently denied the existence of any kind of "magnetic fluid". He had spent a great part of his life in India, where hypnotism is known to be widely employed by the yogi. Faria was the first to prove the possibility of producing hypnotic states by direct suggestion, by the verbal order: "Sleep!"

The scientific era in the study of hypnotism is connected with the name of the English surgeon from Manchester, James Braid, who first proposed the term "hypnosis". Braid induced the hypnotic state in his subjects by means of verbal suggestion, and, in addition, by having the subject concentrate his gaze on some shining object. Such objects weary the sense organs and lower attention, being thus conducive to sleep. He applied hypnosis successfully in surgery. However, even in England Braid's fine work in this field did not clear the mystic fog and mystery attached to anything associated with hypnotism. It was approximately at that same time that Engels wrote his article "Natural Science in the Spirit World", in which he scornfully derided the mystic and religious conception of hypnotism.

Of a certain "hypnotiser" who made quite a sensation in various English towns, Engels wrote: "He was a very mediocre charlatan, who travelled the country under the patronage of some parsons and undertook magnetico-phrenological performances with a young woman in order to prove thereby the existence of God, the immortality of the soul. . . ." Only later, toward the close of the 19th century did the scientific conception of hypnotism and its application in accordance with true medical indications receive definite recognition. The prominent French neurologists Liebault and Bernheim, as well as the famous Professor Charcot of Paris, did creditable work in this field.

However, the interpretations of hypnotism given by Charcot, on the one hand, and by Liebault and Bernheim on the other, varied greatly. The noteworthy point in Charcot's views was his attempt to give a physiological explanation to the onset of the hypnotic state. According to Charcot, the most important factors in hypnosis are monotonous stimuli (stroking the body, the beat of a metronome), or, quite the opposite, strong excitants (a bright light, sudden sounds). At the same time one cannot neglect the fact that Charcot erroneously took hypnosis to be a morbid condition characteristic of a nervous disorder, such as hysteria. On the other hand, Liebault and Bernheim were quite right in declaring that the hypnotic state was a condition of induced sleep, unconnected with any morbid tendencies, and that it might be produced in healthy subjects owing to the existence of such a normal psychic property as suggestibility.

In Russia at the close of the 19th and beginning of the 20th centuries the scientific study of hypnotism and its application in medical practice was greatly furthered by an outstanding neurologist of those days, V. Bekhterev, and by A. Tokarsky, closest associate of the famous psychiatrist S. Korsokov.

Having no desire to lower the merits of Pavlov's predecessors in the scientific study of hypnosis, still it must be noted that only Pavlov completely succeeded in revealing the nature and elucidating the physiological principles of this heretofore enigmatic phenomenon. The works of Pavlov on hypnosis likewise revealed the mechanism of the curative effect of this condition and opened up new possibilities for the application of hypnosis in medicine.

Let us then draw up a short summary of Pavlov's views on hypnosis.

We have already seen that Pavlov defined sleep as being a state of inhibition diffused over the cortex of the cerebral hemispheres and further spreading to adjacent areas of the brain. However, we did not discuss the tran-

sition of the waking state into sleep, nor did we dwell upon the laws that govern the accumulating power of inhibition and its diffusion over the brain. This transition does not necessarily occur all at once, and it may have intermediate phases, when inhibition has spread to separate areas but does not yet involve the entire highest centre of the brain as a whole, alert points still remaining in it.

These states, intermediate between waking and sleep, were defined by Pavlov as hypnosis. *Hypnosis*, according to Pavlov, *is incomplete sleep, sleep accompanied by partial wakefulness.*

The scientist stressed the fact that natural sleep may be accompanied by hypnotic manifestations. He wrote: "The following phenomenon is often observed: inhibition spreads over the cerebral hemispheres and sleep sets in; nevertheless, certain points, which I call points on duty or on guard, may remain active. This is observed, for example, in the sleep of a miller who wakes up when the noise of his mill ceases, or in the sleep of the mother who wakes up at the faintest sound coming from her child, but who is not disturbed by much louder sounds."

The same is observed in hypnosis. Only in this case the point on duty, the "sentry-post" is the alert area of the brain through which its connection (rapport) with the hypnotiser is realised. This is why the subject hears and understands the speech of the hypnotiser, notwithstanding the fact that he is at this time unresponsive to external excitation and to his surroundings, just as is a person in a state of natural sleep.

The likeness of sleep and hypnosis is also confirmed by the conversion of these states into each other. If for some reason or other the hypnotiser does not awaken the subject, the latter's hypnotic sleep turns into natural sleep. On the other hand, it is a well-known fact that some people talk in their sleep and in some cases it is possible to "tune in" to this talk. In this manner a rap-

port is established with the sleeper, and his sleep turns into hypnosis.

The procedures used for producing a hypnotic state do not principally differ in any way from the usual sleep-inducing measures. There is nothing mysterious in the above-mentioned "passes" sometimes used by hypnotisers. They are not essentially different from the light strokes with which a mother sends her child to sleep. The low, monotonous voice of the hypnotiser also has the same effect as any sleep-promoting rhythmic, monotonous stimulus.

When the hypnotiser suggests that the subject is falling asleep in a pose and in surroundings most conducive to natural sleep, he induces hypnotic sleep as a conditioned reflex.

Not only did Pavlov establish various degrees in the manifestation of the spread of inhibition over the brain during the transition from the waking state to somnolence; he also established these degrees for the intensity of the resultant inhibition.

Pavlov differentiated a number of intermediate stages in the transition from excitation to inhibition in the cortical cells; he singled out several so-called "hypnotic phases" characterised by altered reactions of the brain (as compared with the waking state) to external and internal excitation. Certain features in the behaviour of hypnotised subjects may be understood only by taking into account the fact that their brain or its separate areas are in one of these hypnotic phases.

The reaction with which a healthy brain in the waking state responds to intensification of excitation evoking various conditioned reflexes is proportional to this intensification; during the hypnotic phases this so-called law of forces is distorted either quantitatively or qualitatively. In the *equalising* hypnotic phase the brain responds to both strong and weak stimuli by conditioned reflexes of equal intensity. In the so-called *paradoxical* phase the in-

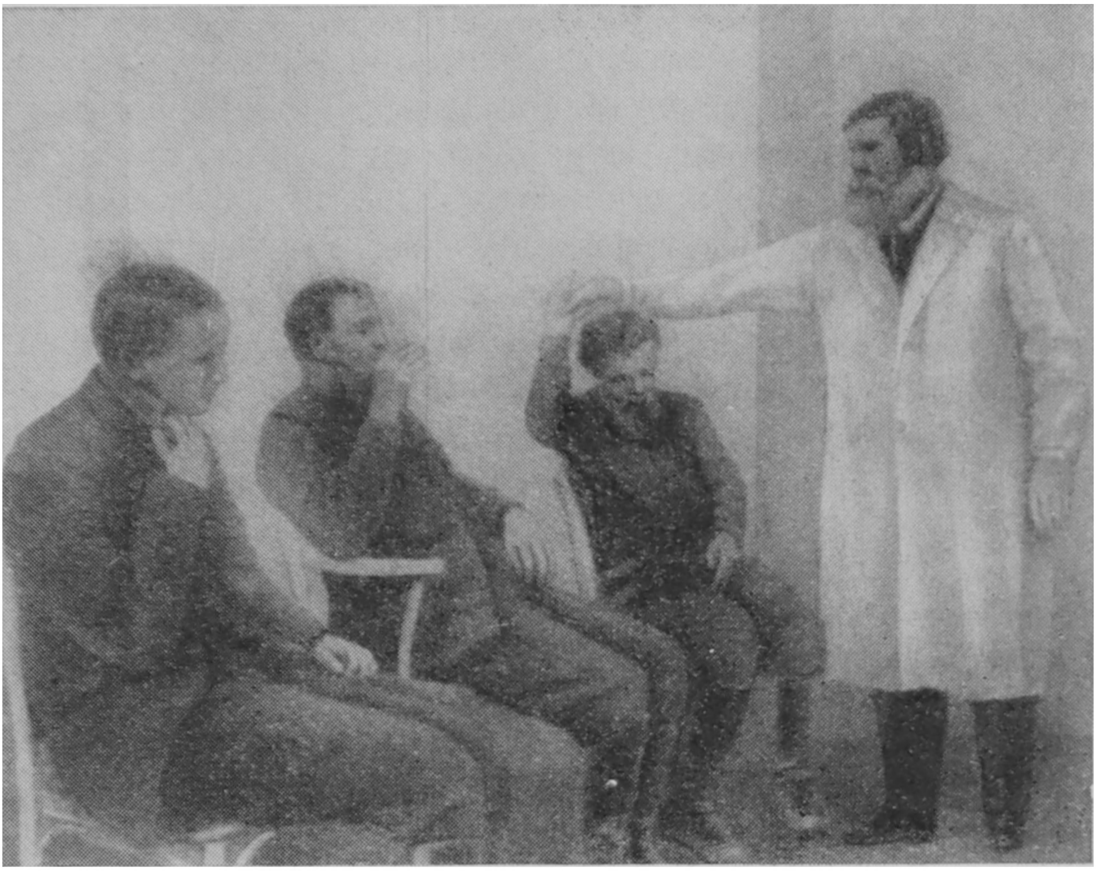


Fig. 3. V. Bekhterev is conducting a sèance of collective hypnosis

tensity with which the brain responds is inversely proportional to the intensity of the stimulus: weak stimuli evoke strongly expressed reflexes, while strong ones evoke very weak reflexes. In the *ultraparadoxical* phase a quantitative instead of a qualitative distortion is observed in the responses to stimulation. The brain responds with deep inhibition to stimuli that should normally evoke conditioned reflex activity, while stimulation that ordinarily leads to inhibition evokes clearly defined excitation.

The *narcotic* phase, as compared with full awakedness, may be characterised by a uniform decrease in reflex responses to stimuli of any intensity.

Finally, in the phase of *complete inhibition* neither positive nor negative stimuli evoke any conditioned reflexes.

Thus Pavlov established that hypnosis, as well as sleep, is based on the process of inhibition. During ordinary sleep the entire cortex of the cerebral hemispheres, as well as the underlying layers, are involved in inhibition; however, during hypnotic sleep cerebral involvement is not universal, inhibited areas alternate with excited areas, the regions of involvement may be quite large, or comparatively small. At the same time inhibition varies in depth and intensity as it passes into the hypnotic phases.

It is noteworthy that the hypnotic state in man differs significantly from the hypnotic state in animals, being, of course, much more complex. This is due to the higher development of the human brain, to the incomparably more complex and perfect nature of man's higher nervous activity (mentality), and, in particular, to the presence in man of a peculiar, qualitatively new and higher class of nervous activity.

In discussing the possibilities of hypnosis as a means of medical treatment we must take into consideration two basic points: first, hypnosis, as well as natural sleep, is, according to Pavlov, protective inhibition of the brain, *rest* for the nervous system, an important means of restoring its vigour; secondly, the hypnotised subject is in a state of *heightened suggestibility*, being easily influenced by the suggestions of the hypnotiser.

The significance of "hypnotic rest" as an important means of restoring vigour and of strengthening the nervous system has been proved by a number of experimental works. A pupil of V. Bekhterev and a prominent figure in Soviet science, K. Platonov, whose contributions to science in the field of medical treatment by hypnosis are outstanding, cites a number of vivid examples of the curative-restorative role of hypnosis as a period of rest for the nervous system. For instance, he found that even twenty minutes of hypnotic sleep markedly heightened and improved the concentration, attention and memory of subjects tired out by a day of work.

According to his data, hypnotic rest restored mental composure in patients with pronounced exhaustion of the nervous system; their appetites returned, healthy sleep, efficiency at work increased, their general condition improved.

The *verbal suggestion* employed in medical aims in hypnosis is highly important; by its means various ideas, thoughts and actions are evoked in the patients.

How did Pavlov explain verbal suggestion, on what physiological mechanisms did he consider it to be based upon? Here we must recall Pavlov's teachings on the second signal system specifically present in man, and on its connections with the first signal system.

Pavlov held that among the hypnotic manifestations in man one is attracted, and properly so, by the so-called phenomenon of *suggestion*. How is this to be understood from a physiological standpoint? Of course, he stated, words are for man just as real conditioned reflex stimuli as are all the others that he has in common with animals, and at the same time words possess such a wide scope of action that no other stimuli do; therefore there can be neither quantitative nor qualitative comparison of words with the conditioned stimuli of animals. Words, thanks to the entire preceding life of an adult human being, are connected with all the external and internal stimuli delivered to the cerebral hemispheres; words signal all of them, replace them all, and can therefore evoke all the actions or reactions of the organism that are conditioned by these stimuli. Thus, suggestion is the most simplified and typical conditioned reflex of man.

Then why does the hypnotiser's word acquire such power, why does the hypnotised subject submit so easily to him, what are the physiological principles of increased suggestibility during the hypnotic state? An explanation to this should be sought, on the one hand, in the isolated action of the word-stimulus issued by the hypnotiser, while on the other one must take into account the changes

in the reaction to stimulation of the brain of the hypnotised subject. Let us dwell on these two points in greater detail.

According to Pavlov, from a physiological standpoint suggestion should be looked upon as an intensive concentrated stimulus that has acquired "a dominant, unlawful and unsurmountable significance". The point of application of such a stimulus is that alert area of the brain by means of which the hypnotiser establishes a rapport with his subject. As this is the only wakeful point in the otherwise completely inhibited brain, the ideas suggested by the hypnotiser and his directions do not encounter any resistance. These ideas are not opposed by contrary thoughts, feelings, or intentions; thus conditions most conducive to suggestion are created. Suggestion may also retain its force afterward, in the waking state. This is so-called *post-hypnotic suggestion.*

How is the success of the verbal suggestion of the hypnotiser to be explained when it is in complete contradiction to reality, when it is absolutely inconsistent with the stimuli coming from the external surroundings that directly affect the sense organs of the subject? If a person who is in an ordinary waking state is given a glass of plain water and told that the glass contains a sweet drink, then he will, on tasting the water, immediately recognise it for what it is, and say in surprise: "What kind of sweet drink is this? It is just plain water!"

Then why does a hypnotised subject take this water after a corresponding verbal suggestion has been made, and drink it as if it really were the sweet and tasty beverage the hypnotiser said it was, his face even carrying an expression of gratification, while the components of the gastric juice he secretes fully correspond to the type of gastric juice secreted when a sweet drink is taken?

All this may be explained by the fact that the hypnotised subject receives external stimuli and reacts to them

according to the laws of the paradoxical hypnotic phase. By these laws, as we have already seen above, the brain reacts to weak stimuli as to strong ones, and to strong stimuli as to weak ones.

Therefore in the battle between these two stimuli, the strong direct one that affects the sense organs, reporting "water", and the weak verbal one that does not correspond to reality, but suggests "sweet drink", the weaker stimulus overcomes the stronger one.

Practice has shown that verbal suggestion and hypnosis may also be employed for affecting the patient's physical state, for regulating the vital activity of various organs and tissues. This opens up wide possibilities for the utilisation of hypnosis in medicine.

Pavlov's teachings concerning the leading role of the cortex of the cerebral hemispheres in the vital activity of the living body, and the role of words as conditioned stimuli, completely explain the influence that various mental conditions, emotional experiences, feelings, and nervous shocks have on the origin and course of diseases of the internal organs. It provides a comprehensive scientific explanation of the manner in which verbal suggestion in hypnosis may affect the vital processes and influence the activity of the internal organs.

However, notwithstanding all manner of favourable conditions for the realisation of the hypnotiser's suggestions by the subject, it must be noted that there are certain limits. Suggestion is effectual when it does not clash with the personality of the subject as a whole, does not oppose his aims in life, his moral and ethic viewpoints, his entire behaviour pattern. This is why the danger of hypnosis being employed with criminal aims is insignificant. For instance, it is impossible to force a person, while he is in a hypnotic state, to perform a crime, or to alter firmly established views, convictions and ideas. Moreover, Soviet law absolutely forbids persons having no medical education to practise hypnotism.

The application of hypnosis as a medical agent has become quite popular in various fields of Soviet medicine. It has proved highly efficient in the treatment of certain nervous disorders, smoothing down nervous emotions in persons who have had severe mental shocks. Hypnosis is particularly successful in the treatment of patients afflicted with all manner of hysterical symptoms.

A good illustration of successful medical treatment by hypnotic suggestion is an observation described by K. Platonov, whom we have already mentioned above. A certain R., a woman of 63 years, was admitted to the neurological clinic headed by Professor Platonov in May 1951; she complained of being obsessed by the thought and apparition of a woman in blue who repeated over and over again, in a most sinister manner, the words: "You shall die of a heart attack!" This frightened the patient extremely, she had sensations of something bumping in her heart, then of pressure in her head. This obsession had brought the patient to a condition when she could no longer perform her domestic duties and had begun to entertain suicidal ideas.

The patient herself considered that her condition had aggravated within the last four years. She connected the disease with a dream in which she had seen a woman in blue who had said in a most impressive manner: "You shall die of a heart attack!" She woke up that morning with sharp pains in the heart, frightened and worried, the dream she had just seen obsessing her mind.

In analysing the mechanism of the formation of this dream it was discovered that the patient, a superstitious and impressionable woman, had visited a "famous" fortune-teller over twenty-five years before; the "clairvoyant" had looked at her cards and said, in a ponderous and impressive manner: "You shall die of a heart attack! Your heart is like a spider web: flick—and you are gone." At first the patient tried to prove to the fortune-teller that her heart was in perfect order and that there could be

no grounds for apprehension. But to this the fortune-teller retorted sharply: "If it's alright now, it will become affected later, as I never make any mistakes in my prophecies." When the patient left the fortune-teller she had for the first time a feeling of compression in her heart, of general weakness and anxiety. She dragged herself home, and for a whole month afterward slept badly, constantly thinking of death. "Because of that fateful encounter with the fortune-teller I have been living in a fog for twenty-five years!" she said to the doctor.

According to Professor Platonov's data, the patient was periodically treated by suggestion while in a hypnotic state, and her fright and obsessions disappeared for long periods of time. During her last stay at the neurological clinic the patient was subjected to six hypnotic sessions, and after a month and a half was dismissed from the clinic in a good condition. She was under medical observation for the following year and a half, remaining healthy.

Various manifestations of morbid alcoholism are successfully treated by hypnotic suggestion. In Russia this method of treating habitual drunkards was first adopted at the close of the last century. Bekhterev was the first to treat alcoholism by so-called collective hypnosis. In proposing this method Bekhterev proceeded from the assumption that besides the psychotherapeutic influence of the physician there also existed mutual induction exerted by one individual on another. After a preliminary psychotherapeutic talk of an explanatory and educational nature a group of alcoholics was sent into a hypnotic sleep; in this condition they were imbued with a repugnance to alcohol and persuaded to refrain from taking alcoholic beverages. Usually the effect of this treatment became apparent after 12-15 séances of hypnosis. Courses of treatment were repeated periodically.

At present hypnotic influence is used for developing a conditioned vomiting reflex to alcohol. This method was put into practice in 1949 by Dr. I. Strelchuk. Patients in

a deep hypnotic sleep are given a whiff of the alcoholic drink they are most addicted to, then a teaspoonful of this liquid is poured into their mouths, and sensations of nausea and vomiting are imperatively suggested to them. After 5 to 8 of such conditioned reflex combinations nausea and vomiting are evoked in the waking state too by the mere odour and taste of alcohol. Hypnosis has also been employed in obstetric practice for inducing painless childbirth.

Professor Platonov succeeded in treating the pernicious vomiting of pregnancy by hypnotic suggestion. At present the possibilities of applying hypnosis to the treatment of a number of internal diseases are being investigated; these diseases are bronchial asthma, ulcers, high blood pressure. Naturally, hypnosis can only serve as one of the links in a chain of other curative measures.

DREAMS, THEIR CAUSES AND NATURE

Man's sleep is usually accompanied by dreams. From ancient times people have been interested in what dreams are and in their relationship to reality.

This interest was first aroused by the peculiarities of dreams. The "dream world" is a remarkable one, often having no resemblance to the real world. Dreams are often entertaining, fantastic, wonderful. This has led to such expressions as "I never even dreamt of this", "It looked like a dream".

In former times the incomprehensibility of dreams made people look upon them as something "supernatural". Before science offered a correct explanation of dreams, people considered them to be mysterious, prophetic. Thus was born the legend of "true" or "prophetic" dreams. The interpretation of dreams became a hotbed in which various prejudices and superstitions flourished. We have already noted that in primitive peoples dreams

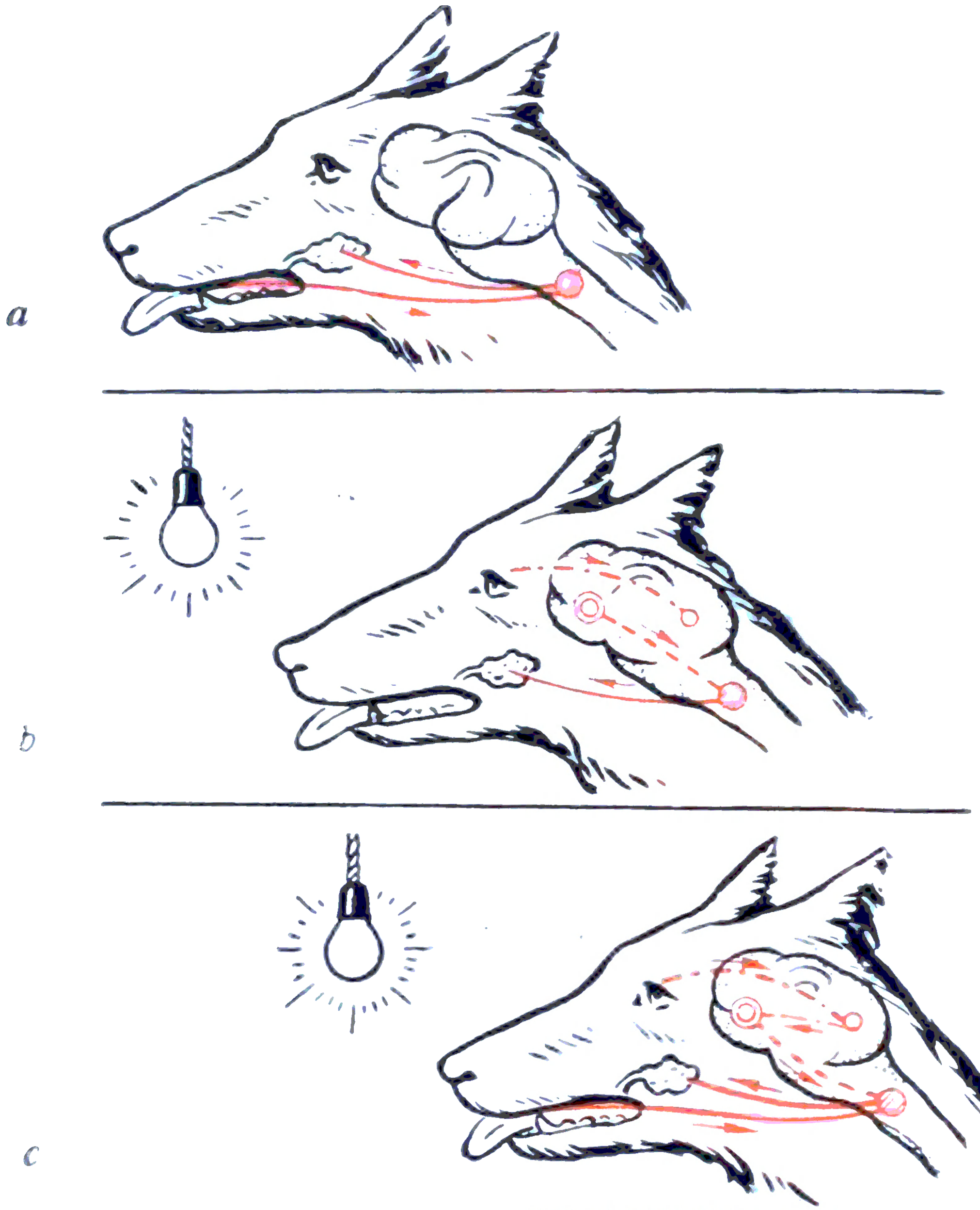


Fig. 2. Schematic formation of conditioned salivary reflex:

a—irritation of taste organ excites salivary centre in the medulla oblongata (shade-lined circle); from here the excitation passes to the nerves of the salivary gland; *b*—the dog sees food; from the visual retina the excitation is transmitted to the cerebral cortex (arrow and circle); the salivary centre in the cerebral cortex (double circle) is connected via the medulla to the salivary gland; *c*—temporary link is formed between both excited areas in the cerebral cortex (faint dotted line and arrow); now visual stimulation alone provokes excitation to the salivary centre.

were the source of a concept of the universal animation of nature, animism. Dreams played a prominent part in the formation of various religious ideas: "the other world", "the future life", and so on. Throughout the history of philosophic thought, beginning with its cradle, ancient Greek philosophy, philosophers of different trends, both idealists and materialists, have manifested a great interest in dreams. Socrates spoke of the divine and prophetic nature of dreams, while another ancient Greek idealist, Plato, held dreams to be a form of the revelation of the soul, the soul's contemplation of the eternal truth. Quite another point of view was that of the materialistic philosopher of ancient Greece, Democritus, who considered that dreams were the continuation of the automatic activity of the brain in the absence of perception.

The founder of scientific medicine, Hippocrates, also recognised dreams as being a product of brain activity. And Aristotle, a great thinker of the ancient world, in his treatise *On Dreams and Their Interpretations* explained dreams as being a natural manifestation of brain activity. Aristotle denied the possibility of foretelling the future by dreams, and, associating their content with the perception of the surrounding world, he called dreams "echoes" of perceptions obtained in the waking state. Such prominent representatives of the materialistic school of philosophy as Titus Lucretius Carus, Francis Bacon, La Mettrie and the Russian thinker Radishchev also considered dreams to be a natural phenomenon, a peculiar form of brain activity. In his treatise *On Man, His Mortality and Immortality* Radishchev spoke of the formation of dreams under the influence of external and internal stimuli, connected with the periods of falling asleep and awakening. However, notwithstanding the progressive character of these ideas on the nature of dreams, they were only speculative, being but bold guesswork not based on precise scientific data. It may be affirmed without exaggeration that thanks to Pavlov's investigations of the

physiology of sleep the age-old "mystery" of dreams was solved, and it was scientifically proved that dreams, as well as mental activity in the waking state, are based on the activity of the cerebral hemispheres, appearing and developing in accordance with the same strictly scientific laws that govern other phenomena in living nature.

How does present-day science explain dreams?

We can judge of dreams by the recollections of people who retain them in their memory upon awakening. An indirect indication is also behaviour during sleep. Remember the happy smile on the face of a child who is dreaming of something very pleasant, or how a sleeping person having a nightmare groans and twists.

Dreams appear only when sleep is not sufficiently deep. People whose sleep is very sound, who "sleep like logs", have no dreams. As we have already noted, any kind of sleep is a checking or inhibition of brain activity. During deep sleep inhibition involves the entire higher section of the brain, the cortex of the cerebral hemispheres, and also deeper formations, the subcortical ganglions, i.e., the entire part of the brain the activity of which is connected with human mentality. When sleep is light, mental life continues, and thus appear dreams, as the activity of the areas connected with their formation is not inhibited. However, if at present the idea that people who always sleep deeply and soundly have no dreams has been sufficiently substantiated, the same cannot be said of the past. The difference of opinion on this question was particularly great among the philosophers and naturalists of the 17th and 18th centuries. La Mettrie, for instance, held that dreams were the result of incomplete sleep, the manifestation of the activity of a partially alert brain; the German idealistic philosophers Kant and Leibniz affirmed that there is no sleep without dreams, as the activity of the soul is continuous.

Often people ask which sleep is the more healthy, the one without dreams, or the one that is frequently accompanied by dreams?

The answer of science to this question is that there is no difference between people who have dreams (if these dreams are not morbid ones, of course), and those who have not, both in their general and mental health.

What are the sources of dreams? Where do their contents originate, what material goes for their formation?

One source of dreams may be stimuli arriving from the outer world; these stimuli, in a distorted form, are percepted by the light sleeper. Thus, for instance, take a person asleep at home near a summer garden where a brass band is playing; he dreams that it is a festive day in May, and that he is on an outing in the country. A brass band is playing, happy faces surround him, and he is dancing with a wonderful girl dressed in a light-coloured summer frock who is whispering pleasant nothings into his eager ear.

If we compare the dream and reality it would seem at the first glance that there is nothing in common between them. A man lying asleep in bed at home dreams of a gay outing in the country. However, one cannot ignore the fact that he sees this dream at the very time he can hear the music of a brass band, and that such music also figures in his dream. It is clear that the stimulation caused by the music is percepted by the sleeper and transmitted to his brain, where it evokes a series of images and ideas associated with this sound stimulant.

Another important moment is that one and the same stimulus of the sense organs may call forth different dreams at different times. The German scientist Hildebrandt graphically describes three different dreams of his, all associated with the sound of an alarm-clock: "And so I go out for a walk one fine spring morning; strolling along thus, I come to a neighbouring village. There I see the inhabitants decked out in their best attire, carrying their hymn books under their arms, and all going to the church. Quite right! Today is Sunday, and the early morning service is about to commence. I decide to attend it, but first

I want to rest a little in the churchyard, as I am a bit hot after my walk. And while I am reading the inscriptions on the gravestones I hear the bell-ringer ascending his belfry, and notice a small village bell at its very top; this bell is to ring the beginning of the service. For quite a while the bell hangs motionless, then starts swinging and suddenly I hear its loud and piercing ring, so loud and so piercing that I wake up. It turns out that these sounds are issued by my alarm-clock.

"The second dream: It is a clear winter day, the streets are still covered with snow. I have promised to go for a sleigh-drive but quite a long time goes by before I am told that the sleigh stands at the gate. Then begin my preparations for the drive—I put on my fur coat, take out my foot-bag, and at last I am seated in my place. However, the departure is delayed, then finally the impatient horses are given the signal with the reins. They plunge forward; the wildly dangling bells begin their famous Janizary music, with such force that the thin web of my dream is torn. Again it is no more than the piercing ring of my alarm-clock.

"And still a third example. I see the kitchen maid going along a corridor to the dining-room, holding a stack of several dozen plates. It seems to me that the porcelain pillar she is carrying is in danger of toppling over. 'Have care,' I say to her, 'the whole stack will crash to the floor.' Naturally, the inevitable retort is that 'it is not the first time, I am already accustomed', etc., while I do not remove my troubled gaze from the walking girl. And verily, she stumbles over the threshold and the fragile dishes fall with a ringing crash, breaking into hundreds of fragments. However, I soon notice that the endless ringing does not resemble the sound of breaking dishes at all, it is real ringing, and it comes, as I already understand, from my alarm-clock."

These examples are a vivid illustration of the role stimuli originating in the environment play in the formation

of dreams. In all three dreams the external source was one and the same, the alarm-clock. But how differently it sounded in the different dreams: first like a church-bell, then like sleigh-bells, then like breaking dishes. The decisive factor was the general atmosphere evoked by an association of ideas, the common subject of the scenes seen in the different dreams.

In the waking state, too, any external stimulus may evoke various associations, calling forth ideas associated with former experiences in which this stimulus participated. Thus, a certain sound may remind a person of the lapping of the waves by the seashore, or of thunder during a storm, or of the distant sounds of battle. During sleep the various stimulations coming to the brain from outside, the sensations transmitted by the different sense organs, usually evoke the most fantastic and diverse association of ideas that screen, for the most part, the real sources of these stimuli.

How these actual stimuli are hidden behind various associations of ideas in dreams has been vividly described by Lev Tolstoi in his story "The Blizzard".

While making a journey in the winter, the hero of this story was overtaken by a snow-storm; freezing with cold, he fell asleep.

The narration, told in the first person, describes how the sound of the harness bells was transformed in the traveller's mind. "I was fast asleep," writes Tolstoi, "but I heard the bells all the time, and I saw them in my dream, first as a barking dog jumping on me, then as an organ in which I myself was but one pipe, then in the form of French verses I was compiling. Then it seemed to me that the bells were some sort of instrument of torture that was compressing my right heel. The pain was so acute that I woke up rubbing my foot; it had begun to freeze."

Another characteristic detail is that the external stimuli delivered to the brain during dreams become distorted

not only qualitatively, but also quantitatively, weak stimuli evoking very strong sensations. In a dream a person hears deafening gun-shots; when he wakes up he finds that the source of his dream was only the low puffing of a boiling kettle in an adjacent room. The sleeper dreams that he has been stabbed to the heart with a sword, but the cause of the dream was only the bite of a mosquito. Here is an observation dating back to Aristotle. "During sleep," he wrote, "weak irritants are experienced as strong ones, a weak noise seems to be the rumble of thunder, while slight warmth feels like intense heat."

Another source of dreams may be the stimuli originating in the body of the sleeper, in his internal organs. Their causes are diverse: an uncomfortable position of the body, full bowels, extended bladder, strained heart activity, or difficulty in breathing.

Thus, for instance, a nightmare accompanied by fear of death is observed in cases when cardiac activity during sleep is constricted for some reason or other. If the sleeper's breathing is laboured, he may dream that he is being choked, that somebody is sitting on him, or that he is drowning.

Scientists have repeatedly attempted to establish the connection between dreams and various external and internal stimuli by means of special tests on sleeping subjects. The French investigator Alfred Maury describes such experiments that were performed on him by his request. An open bottle of perfume put to his nose made him dream of a perfumer's shop, of Cairo, of the Eastern lands he had recently travelled to. When a red light was shed on his face the sleeping Maury dreamt of storm, thunder, lightning.

The Norwegian scientist Vold Mourly experimented on sleeping subjects by fastening their limbs in various positions before they had fallen asleep, and then noting how this affected their dreams.

However, experiments of this type encounter many obstacles. External stimulation often awakens the sleeper, and upon awakening people subjected to various irritations frequently do not remember their dreams.

According to one of Pavlov's pupils, Maiorov (we have already mentioned him), greater success was attained in investigating dreams seen during hypnotic sleep. Such experiments were conducted by I. Volpert in the laboratory headed by Maiorov. Volpert sent his subjects into a hypnotic sleep, suggesting and impressing on them that they must remember and be able to describe their dreams upon awakening; he then combined the general suggestion "You are dreaming" with this or that external stimulation. It appeared that when a test tube filled with hot water was put to the forehead of a hypnotised woman she dreamt that she was at the Crimean seashore, where it is very hot.

However, the greatest source of dream material is the store of ideas, recollections, and impressions retained by our memory. The physiological basis of memory is the traces left in our brain by previously received stimuli. In dreams these weak traces of former stimuli turn into vivid images and evoke various emotions. At the same time the principle of "selection" of material for dreams may be of the most diverse nature.

Very often people have dreams that reflect their everyday occupation and the emotions associated with it. Thus, for instance, an artist who is painting a picture and is entirely absorbed by his work may often continue seeing this picture in dreams, sometimes as already finished, sometimes as unfinished. In wartime soldiers often have dreams in which they again go through battle scenes they have participated in. In the long-gone past Titus Lucretius Carus observed that dreams reflect the things that people are most occupied with in their waking state, the matters that are most important to them, that attract their utmost attention. This is what he wrote of such dreams:

If one diligently some matter pursues,
Or if for a long time in something absorbed we have been
And on this our thoughts incessantly dwell,
Then in our sleep we seem to be doing the same:
The lawyer his litigations continues, draws up his deeds of transaction,
The general sets out for the wars and engages in battle,
The helmsman in continuous strife with the sea winds abides. . . .

Many examples might be cited of dreams that chiefly reflect the deepest recent impressions. Dreams often express strong emotions, innermost conflicts, unsatisfied urges, apprehensions and other feelings that move man.

A unique description of such a reflection of anxiety in dreams was given by the Russian poet Alexander Pushkin in his poem "The Bakhchisarai Fountain". A eunuch has fallen asleep while guarding the palace and harem of his master:

Suspicion kept his fancy waking,
And on his mind incessant preyed,
The air the slightest murmur breaking
Assailed his ear with sounds of dread.

Now, by some noise deceitful cheated,
Starts from his sleep the timid slave,
Listens to hear the noise repeated,
But all is silent as the grave.

Another vivid example is a story by V. Korolenko, "Makar's Dream". The writer depicts with great artistic skill the reflection in a dream of the deep emotions of a Yakut peasant living in old Russia in conditions of hopeless poverty, inhuman exploitation, mockery and oppression. The most vivid pages in Korolenko's story are those describing the trial Makar is put to, when he dreams that he, always so downtrodden and humiliated, suddenly

speaks loudly of his hard life, of his innermost desires, of his right to a better life.

Lev Tolstoi in his *Anna Karenina* describes the dream Anna had at the height of her emotional drama, when she was faced with the agonising and constant dilemma of what to do in the conflict between her conjugal duty and her strong feeling for Alexei Vronsky. This dream may serve as an illustration of the reflection of strong emotions in dreams. "There was one dream," says the book, "that troubled her almost every night. She dreamt that they were both her husbands, that both of them offered their endearments. Alexei Alexandrovich wept, kissing her hands, saying: 'How fine everything is now!' And Alexei Vronsky was also present, and he, too, was her husband. And Anna, surprised that she had previously thought all this impossible, explained laughingly that it was all much simpler and that they were now both content and happy."

We have cited examples showing the reflection of particularly strong feelings and emotions in dreams.

However, often a dream may be based on some insignificant impression, some casual remark or word. Dreams may even be founded on forgotten events of the past that lead back to youth or childhood. An example of this is an interesting story by the above-mentioned well-known French investigator of dreams, Maury. The first years of Maury's life were spent in Meaux, and he often visited a neighbouring village called Trilport. Subsequently he departed from the district for a long time. But once, many years later, he dreamt that he was again a child in Trilport. Near him stood a man attired in something resembling a military uniform. When asked who he was, the man gave his name and surname. Upon waking Maury decided that his dream was pure fancy, and he could not remember ever having known such a person. But an old servant of the family told him that such was the name of the watchman who guarded a bridge that was being built by his father when Maury was a child. "The dream evoked

my memory, though it seemed to tell me something I knew nothing of...," says Maury in concluding his story.

Everything we have seen, heard, or felt, anything we have experienced, leaves a trace in our brain and is retained by our memory. During dreams parts of these traces may be stimulated by one or another cause: the images and ideas are dug out of memory's storehouse to take the form of a dream. Thus we see that dreams bring us nothing essentially new, and that there is nothing in them that the individual has not experienced or thought of in the past. That this is so is vividly confirmed by the nature of dreams of people in whom the perception of some sense organ has been absent from birth, such as the blind or the deaf.

Investigations of this type, particularly the dreams of the blind, were carried out by Dr. K. Grinyova; she established that people who have been completely blind from their very birth have no optical images in their dreams. Thus, for instance, J., a man of forty, blind since birth, told her that the river and trees in his dreams were connected with sounds and odours only. In his dreams he recognised people by their voices, and defined the shape of objects by touch. Many other analogous observations have been made.

"I know Mother in my dreams only by her voice," said another blind-from-birth patient investigated by Dr. Grinyova. "I do not see the trees and flowers in my dreams."

It should not, however, be assumed that in every single case the dream has some definite source. Often dreams are of a very complex nature, and they are due to a combination of both external and internal stimuli and are influenced by experiences of diverse character and remoteness. To cite an example of such a complex dream we may offer the dream of Alexei Kovshov, one of the personages in the novel *Far From Moscow* written by the Soviet writer Azhayev.

"Finally Alexei fell asleep,—was it for an hour or a minute? And he dreamt of various trifles. Yet, when he awoke, his face was wet with tears. In his dream he had been at the Agricultural Exhibition in Moscow, sitting with Zina in the porch of the Pavilion of the North. They were having ice-cream and strawberries. Zina spooned a large berry, and, offering it to Alexei, said: 'Isn't this a bit better than your Far Eastern bilberries?' And Alexei could not hold back his tears.

" 'What makes you cry, Alyosha?' asked Zina, bending toward him to dry his tears with her lace handkerchief.

" 'How we have changed! How happy we were, like innocent babes!'

" 'Were?' asked Zina in surprise. 'Are we then dead? I cannot understand you, Alyosha.'

" 'No, we have changed now,' was his answer. And he wanted to add that the war had put an end to their serenity, but refrained, thinking: 'There's no need to trouble her prematurely, let her live a little longer in peacetime.' "

In discussing this dream it should be recalled that it was very cold in the room where Alexei Kovshov lay asleep. According to the author's figurative description, "Kovshov's hair froze to the metal bedstead". Another important point was the fact that Kovshov was greatly mortified at being sent to work in the rear while his beloved, his wife Zina, had been sent on a secret assignment to enemy-occupied territory.

Both factors were reflected in Kovshov's dream, knitted into an intricate pattern of associated memories.

The feeling of cold during sleep was associated with the ice-cream Alexei saw in his dream; his anxiety about his wife was reflected in their dream encounter, in their talk, in his tears.

In speaking of the content of dreams we must remember that the most insignificant stimulation of any of the sense organs may cause a dream, the sensations of which spread far beyond the boundaries of this elementary ex-

citation. A highly interesting book in this respect is that of O. Skorokhodova, entitled *My Perception and Conception of the World*, particularly the chapter in which the author, a blind and deaf mute, gives a detailed description of her dreams and attempts to explain them. Skorokhodova became blind, deaf and dumb when she was five years old, after a severe disease. Notwithstanding her grave disabilities, she has attained much in life, received a university degree, and is engaged in writing.

The following is one of Skorokhodova's dreams, in her own words:

"I remember this dream, one that I had in my youth. It appeared to me that I heard sounds, and I thought that they must be singing. But it seemed to be the voice of some little bird, not of a human being. The singing was so loud, so clear, so solemnly did it sound over my head that I felt my heart stop beating from sheer rapture. And there was but one thing I was afraid of—that the singing would stop. And I thought all the time of who the singer could be, and then I guessed: 'It is a nightingale!'

"I have never actually heard, felt, or sensed the singing of a nightingale, have never even held one in my hands. But in my dream the wonder of the song became greater and greater, it seemed to be approaching me from afar on a mighty wave of sound. Then the wave seemed to be receding from me. The singing became fainter and fainter, until it stopped altogether. I was very perturbed when this delightful dream ended, and even woke up in distress. And what was it? I had simply been hearing the loud buzz that never leaves my head day or night. At times it is lower, sometimes it quiets down altogether, but usually it is very loud. However, I was never sorry that on the night I am speaking of my buzz arranged such a beautiful concert for me! Yes, but why did I take the singing for that of the nightingale, and not of any other bird? The explanation seems a very simple one to me. People who hear have often told me how wonder-

fully the nightingale sings, and I have read about it in books. I know the words of many songs about the nightingale."

All the above gives us a better insight into the excellent definition of dreams made by I. Sechenov. He called them "an unusual combination of past impressions". Pavlov says the same thing when he defines dreams as a combination, "in a most unexpected manner", of the traces of former stimuli received by the brain.

Such are the views of Sechenov and Pavlov on the sources of dreams and on their general physiological nature.

It is worth while to comment on another, quite an opposite explanation of dreams offered by the Viennese neurologist Sigmund Freud. There is not enough place in this booklet to dwell at length on Freud's views concerning dreams, so we shall present only a short critical review of the more important of his affirmations in this field.

Freud's first proposition is that dreams always reflect hidden, unrealised, thwarted desires and feelings of people. Freud completely reduces all these human feelings and desires to sexual feelings and desires, to their sources and inhibitions that often go back to the earliest periods of childhood.

The importance of the sexual instinct in human life is not to be denied; it is, however, wrong to ignore, as Freud does, the wealth and diversity of human emotions which cannot be reduced to sexual feelings and desires alone. Dreams, as we have shown above, can reflect many sides of an individual's personality, his interests, experiences, his aspirations and inclinations, his everyday occupation, his store of knowledge, the order and nature of his emotions. We have cited many examples of dreams in which there are absolutely no direct nor hidden hints at any sexual emotions. The number of such examples might be expanded significantly. What is more, it may be con-

fidently asserted that obvious or hidden sexual emotions of experiences occupy a comparatively small place in dreams, significantly smaller than do feelings reflecting other most diverse manifestations of human life, as, for instance, professional occupations, or creative endeavours in science or art that fascinate and completely absorb the mind and thoughts.

Let us recall that dreams often reflect the wide range of impressions and events of the preceding day, or memories of the past, and again these impressions and events have no connection with sex in the majority of cases. Freud could not but know all this. And how did he cope with this difficulty? How did he strive to protect his "sex theory of dreams"?

Here we encounter Freud's second basic principle: dreams are always of an allegoric, symbolic nature. Let us see just how he understands this symbolic language of dreams. Science demands that the scientist be unbiased, that his conclusions rest on confirmable facts. Freud follows another path. In his interpretation of dreams he proceeds from the logic scheme he himself created, from the ideas and thoughts he himself invented, handling facts in a most tendentious manner. The symbolic language of dreams is deciphered arbitrarily, with no argumentation adduced. This pertains, for instance, to the unsubstantiated analogies that Freud makes between various objects seen in a dream and the sex organs. If one sees an umbrella, why, then consider it to be the male organ, while a room in a dream dominates the female organ. Such is the ostentatious manner in which Freud treats individual episodes in the sex life of his patients to interpret their dreams and establish a connection between these episodes and the content of this or that dream. In order to establish such a connection Freud again resorts to an arbitrary interpretation of the symbolic language of dreams.

It is also a mistake to consider, as Freud does, that symbolism is the universal and obligatory law governing the formation of dreams.

Above we have already cited a number of dreams reflecting events in people's lives, events that entirely absorbed them, engrossed their minds, or, in the language of physiology, events of a dominant nature. It is important to note that in these cases the emotions did not acquire any fantastic or symbolic expression. Even various experiences connected with sex may manifest themselves in dreams in their real form, and not in the shape of symbols. These are the so-called "voluptuous" dreams that occur during nocturnal pollutions, during protracted abstinence from sexual intercourse.

It should also be borne in mind that when Freud speaks of the symbolism of dreams, stating that dreams provide the realisation of frustrated feelings and desires, this is in itself a confirmation of the obligatory presence of a hidden meaning to dreams.

Freud endeavours to present the absurd content of many dreams as being psychologically substantiated, almost "reasonable", while actually their physiological source, as we shall see later, lies in altered brain activity during sleep. We believe that the groundlessness of this assertion can best be disclosed by a detailed exposition of Pavlov's teachings on the peculiarities of dream thoughts and of their physiological mechanisms.

It is a characteristic feature of thoughts in dreams that they appear for the most part as vivid images, while it is most unusual to think in abstract ideas in a dream. Hence the expression "to see a dream". If in the daytime a certain person is spoken of in an uncomplimentary manner, if it is said of this person that he is "a dark one", then somebody who participates in this talk may have a dream in which the words "dark one" will not figure, but the sleeper may see the person spoken of in a black suit, for instance, or as having a dark-coloured face. When it

said that so-and-so has "an iron hand", meaning that he is a strong-willed person, then in a dream he may appear as having an iron hand or holding a sword. It is evident that both these dreams reflect concrete visual images, but are an erroneous reflection of thought. Cannot a "dark" personality wear a light-coloured suit? Personality and clothes are not one and the same thing. However, such an interpretation of waking-state thoughts into concrete, mostly visual, images is highly characteristic of dreams.

The absence of any critical attitude toward absurdities is also characteristic of dream-thinking. Everything is possible in a dream: communication with the dead, simultaneous presence in different places, life in the distant past. There are no limits to space or time in dreams. A thing that in the waking state would immediately be rejected as absolute nonsense may call forth no doubts in a dream.

The merging and substitution of images is typical of dreams. A small extract from the description of Tatyana's dream in Alexander Pushkin's novel in verse, *Eugene Onegin*, is a vivid example of such a merging of images:

About the table monsters sit!
One is a horned and dog-faced creature,
One has a cock's head plain to see,
And there's a witch with a goatee,
A dwarf, whose tail is quite a feature,
A haughty skeleton, and that
Is half a crane and half a cat.

Certain of the Greek myths, some of which evidently are descriptions of dreams, may also serve as a good illustration of the merging of images. One needs but recall the myth of the man-horse Centaurus. A convincing illustration of the substitution of images in dreams is the description of a dream by Professor Y. Popov in a work devoted to an analysis of dreams. In her dream his patient

saw herself running around in a room, and it seemed to her that her loosened hair blowing around her face consisted of tongues of flame. She was even afraid that the furniture might catch fire. And at the same time she asked herself: "But how can I have hair of fire, my hair is not red, it is brown."

This example shows clearly how the figurative comparison "hair red as fire" is substituted in a dream by hair in the form of tongues of fire.

The merging and substitution of images in dreams often makes these dreams so absurd that both content and source become obscure. There seems to be nothing resembling real events in such dreams.

It is often difficult to determine the source of a dream because the memorising of various phenomena may occur without the person being aware of it. In these cases it is only by means of indirect indications that it becomes clear what events in a person's life were impressed on his memory and served as the basis for this strange dream.

The following is an example. A lecturer, N., came to the city of Astrakhan for several days; on the first night he had a dream in which an acquaintance of his, a member of the Academy of Sciences, was standing at a street crossing in a militia uniform regulating the traffic with a long sausage.

The origin of this absurd dream was incomprehensible to N. He hadn't even as much as thought of the Academician before he went to bed, no militiaman had accosted him, he had bought no sausages. In a word, he had apparently nothing in common with any of the phenomena of his dream.

However, a few days later, when N. was departing from Astrakhan, he suddenly understood what had caused his dream. On the way to the station he noticed a sign on a house; this sign carried the name of a physician, and it was the same as that of this learned friend. Evidently,

he had noticed this sign on the day of his arrival, but had paid no particular attention to it. He also recalled that the traffic man on the cross street had been assiduously regulating a very thin trickle of traffic. And what is more, when N. was thinking over the origin of this dream, he became aware of the fact that his hotel window had looked down upon a new delicatessen shop, which is quite a natural association with sausages.

If the merging and substitution of images in dreams be taken into account, then the source of N.'s dream becomes clear. The coincidence of the physician's name on the sign with the Academician's evoked the image of the latter in a dream, and this image merged with that of the militiaman. The militiaman's traffic stick was replaced in the dream by a sausage, an association with the delicatessen shop that had attracted N.'s attention.

It is obvious from the above examples that thoughts in dreams appear in the shape of images, that they are non-critical and chaotic.

But why is it that the manner of thinking alters so in dreams? Why is the appearance of images in dreams so accidental and contradictory, why are their combinations so unusual, what causes their merging and substitution?

The explanation lies in a number of causes, primarily in a disturbance of the united, dynamic entity of brain activity by the gradually increasing inhibition of sleep.

We have already noted at the beginning of this chapter that during deep sleep a person sees no dreams. Dreams only appear when sleep inhibition is not sufficiently deep nor intensive and does not involve all the sections of the brain. Such inhibition leads to the exclusion of separate areas of the brain, to a weakening of the activity of some and the abnormal intensification of the activity of other areas. The general result is a disturbance of the co-ordination and interaction of the different parts of the

brain. Hence the replacement of the orderly mental activity internally unified by the higher nervous activity, characteristic of the waking state, by the chaotic, absurd thoughts typical of dreams.

Another essential factor conditioning the peculiarities of dream thoughts is the fact that during sleep the second signal system is the first to be inhibited; this system is more delicate, complex, and easily exhausted. As we have already seen, the human faculty of abstract thinking, according to Pavlov, is connected with the second signal system. The first signal system is the carrier of thoughts in concrete, vivid, sensual shapes. During sleep accompanied by dreams inhibition predominantly involves the second signal system, while the first one becomes activated (de-inhibited). This is the cause of the graphic form of dreams. The same explanation may be applied to the two other characteristic features of dreams, their uncritical nature and disorderliness. The second signal system, being the carrier of higher, abstract human thinking, chiefly determines a person's capabilities, his ability of correctly estimating his perceptions, of establishing correlations between his perceptions and impressions on the one hand and former experiences and reality on the other. Since during sleep inhibition involves first of all, and predominantly, the second signal system, the sleeper does not notice the absurdity of dream events. Moreover, inhibition of the second signal system leads to the exclusion of its guiding principle in mental activity and of the function peculiar to this system—that of governing and regulating the entire nervous activity. This, to a certain extent, explains the chaotic thoughts in dreams, the substitution and merging of images and the development of unrestricted, absolutely uncontrolled fantasies. Finally, in order to understand the physiological mechanism producing dreams one should recall the distorted reaction of the brain to external stimuli so typical of the hypnotic

phases; the stimuli that usually excite certain areas of the brain do just the opposite, evoking inhibition, while the inhibitory stimuli, on the contrary, unexpectedly excite one or another section of the brain. But this is precisely what is typical of dreams!

The weak traces of former stimuli in a brain in the paradoxical hypnotic phase acquire traits of very strong and intensive excitants, therefore they no longer remain dim memories, but become just as real and vivid as they were in the waking state. That is why the hazy recollection of some long dead acquaintance may suddenly appear in a dream as such a vividly realistic apparition as to seem to be a real and living person. That is why a small hillock may turn into a mountain, a grown man into a child, a friend into an enemy. That is why a sleeping person can have vivid dreams formed on the basis of the weak traces of former excitations, while at the same time he does not perceive real, intense stimulations coming from the outer surroundings.

The scientific interpretation of the production of dreams facilitates the complete routing of the legend of "prophetic", "true" dreams, makes clear the absurdity of superstitious interpretations of dreams.

People who believe in "true" dreams affirm that during a dream one may obtain some specific *premonition* of important events. And they try to prove this by citing examples of the coincidence of *omens* and of dreams that have "come true".

Let us see, first of all, just what premonition is.

Suppose that in the waking state an individual, by circumspectly weighing and analysing all the pros and cons of certain events and conditions concludes, on the basis of his former experience and by logical thinking, that this or that event will occur, and then it actually does occur, do we then call such a fact premonition? No, we say that this was prediction inspired by experience and

knowledge. Such predictions are inalienable from science. It is on the laws governing the development of phenomena and processes in nature and society that scientific prediction is founded, beginning with weather forecasts based on meteorological data, and ending with the prediction of the inevitability of social revolution based on the Marxist-Leninist theory of the development of society.

Quite another matter is talk concerning premonitions. In these cases people do not mean predictions founded on life experience and science, they are thinking of predictions allegedly inspired by a certain peculiar clairvoyant sense. Moreover, they recognise some mysterious faculty of perceiving the thoughts of others, of enjoying common sensations with others, of learning of certain events occurring at great distances by some kind of "super sense".

Such transmission of thoughts and feelings over great distances enacted by some "specific sense", not by the usual routes of modern engineering—TV, radio, telephone and telegraph—is completely rejected by science. To recognise "premonition" as a form of cognition would be the same as admitting the existence of a mysterious "all-aware" soul, taking the false positions of idealism and mysticism.

Everything we have said of prediction in general is directly related to premonitions in dreams.

The following example is quite illustrative. A certain person affirms that he dreamt he saw his father, who lives in another city, dying, and that his father really did die that very same night. The person who had this dream sees in it an unshakable proof of the fact that he had by some specific sense felt the death of his father.

In explaining such allegedly "prophetic" or "true" dreams one must take into account, first of all, that when closely connected people are separated they often think

longingly of their dear ones, are anxious and worried about them, and this cannot but be reflected in their dreams. Secondly, if people are truly close they usually know all about each other's affairs, and may foresee many things on the basis of a previous long period of living together, by the facts and tone of a last letter, or by chance news. It is important to bear in mind that a person is not always aware of how well he knows his near relatives or close friends. And, thirdly, very often an unintentional distortion of facts occurs in remembering them, under the influence of emotions. A person learns of the death of a dear friend or close relative. He is overcome by grief, disturbed, full of longing and sorrow. In such an emotional state of perturbation an ordinary dream—a coincidental recollection of the departed friend or relative on the day of his death—subsequently appears in an altered shape. Such dreams are often remembered as having been particularly vivid, significant, and thus the false conclusion: "I had a premonition of my father's death in a dream."

Purely accidental coincidences may also frequently occur. It is interesting to note that thousands, no, millions of facts of dream "premonitions" that do not come true are usually not remembered, and no attention is paid to them, but let a single instance of "realised" prediction occur, and it is immediately pounced upon as being a true "premonition" from which general inferences are drawn, although it may be due to a number of causes, or to a purely incidental coincidence.

Here is another example of a dream apparently coinciding with reality, something like foresight in a dream. A certain teacher had decided to move to another part of the country, to Estonia. He made a preliminary trip there, to negotiate his future work. On the way he had a dream; he appeared to find himself in a room with an unusual, domed ceiling, and his reception was a very unfriendly one, so that he was forced to reject the position. Upon

arriving at his destination the teacher immediately noticed the ceiling: it was indeed very like the one he had seen in his dream, and, although he was formally not turned away, still he clearly felt that his candidacy was undesirable, therefore he refused the job himself and went back home. And thus it would seem that he really had had a "prophetic" dream. However, another, a correct explanation may be given to this dream.

When the teacher was travelling to the place of his future work he could not but think of whether he would be accepted in a friendly or unfriendly manner, of whether he would remain there or not. In this manner of thinking he might have been in a happy and confident mood, or, on the contrary, he may have been anxious and uncertain. The dream, reflecting his mood, was a troubled one; however, upon awakening, the teacher overcame this anxiety by logical thinking, and did not turn back on the way. However, upon getting a not too friendly reception, and, moreover, the conditions turning out to be none so good as he had expected, he departed. Does this mean that there was any element of premonition in his dream? We think not. The teacher might have been given a good or bad reception. It turned out to be a bad one. So what is so unusual in this? A simple coincidence. And besides, the teacher could not judge objectively of the attitude toward him, as he was under the influence of the mood brought on by his dream.

It is more difficult to explain the coincidence of the domed ceiling. The first version of such an explanation may run thus: the teacher had not undertaken his trip out of the blue, he had first received some information about the school to which he was going. He had learned that the school occupied the premises of a former monastery, but had at the time paid no particular attention to this. However, this information had been imprinted in

his brain, and during sleep it appeared in the shape of a room with a domed ceiling.

The second version: when people are tired (and the teacher *was* tired after his long journey) a phenomenon may be observed in them that psychologists call "symptom of visual repetition." An individual sees something or somebody for the first time, but he has a harassing feeling of having already seen or gone through this event in reality or in a dream. This is a trick of memory, a delusion. Perhaps this symptom was manifested in the teacher under the effect of anxiety and fatigue.

Let us dwell briefly on signs in dreams that are allegedly omens of impending bad luck, tokens that unfailingly determine events in real life.

How are separate instances of the coincidence of dream signs with reality to be explained? There may be quite a few such explanations. We shall cite but one.

It is first of all necessary to take into account the attitude toward dreams of different people, that is, how superstitious a given person may be, how susceptible to suggestion. Years ago the Russian neurologist Bekhterev said that dreams might, in the form of autosuggestion, influence a person's behaviour in the waking state. A person who believes in "evil-omened" and "good-omened" dreams and is susceptible to autosuggestion may act in accordance with his superstitious ideas. An "evil" dream upsets him, he becomes confused, inactive, his work falls from his hands. And just the opposite, a "good" dream gives him confidence, makes him spright and lively. Therefore such a person often thinks that an "evil-omened" dream leads to unpleasantness, while a "good-omened" one foretells good things to come. However, in reality it is not the dreams that affect the development of events, but the person himself, without even being aware of it.

DIFFERENT STATES OF SLEEP AND CONDITIONS CONDUCIVE TO SLEEP

In discussing the physiological nature of sleep, hypnosis and dreams we have repeatedly noted the character of inhibition of the higher nervous activity that underlies these phenomena. We pointed out the indissoluble connection between phenomena of sleep, hypnosis and dreams, and the complex fluctuating relationships existing between them. There are various transitory stages in normal physiologic sleep between the waking state and sleep, and vice versa. Moreover, the conditions producing sleep also vary. First of all, the state preceding sleep, *drowsiness*, must be differentiated from sleep proper.

As the need for food is expressed by hunger and for water by thirst, so is the need for sleep expressed by a specific condition, drowsiness, when, as it is said, one's head becomes "heavy with sleep". The muscles become loose and flabby, the person starts yawning, stretching, it becomes difficult to concentrate on anything, to continue work. If for some reason sleep is prevented, the person feels indisposed, in a bad mood, irritable. The state of drowsiness is a signal: time to sleep! This signal precipitates a number of deliberate actions aimed at preparation for sleep.

The onset of sleep is preceded by a characteristic period of falling asleep. The world with all its wealth of sound, shape and colour recedes out of sight and hearing. External stimuli begin coming to the mind through a thick layer of cotton wool, as it were. Gradually the person stops understanding the sense and significance of words addressed to him. His body weakens, his eyes become heavy, then shut, his head falls to his chest, his thoughts become confused, chance images appear, and suddenly he is asleep. If this stage of falling asleep does not terminate in full sleep, being expressed in a partially retained perception, in a fluctuating contact with the

surroundings, accompanied by no active participation of the subject himself, then such a condition is called *dozing*.

An intermediate position between sleep and the waking state is also that of *awakening*. At times a sharp and definite transition from sleep to the waking state is noted. But in the majority of cases the process of waking up is slow and gradual. A person who is awakening is alternatingly clearly aware of his surroundings and reacts to them or again falls asleep. Often awakening is characterised by a peculiar condition during which the surroundings are cognised only partially, or in a distorted form, and therefore the subject's behaviour is often unreasonable.

The onset of sleep calls for corresponding conditions, and first of all for the body to be in need of it.

These requirements are not uniform. They depend on age, condition of health, habits and training. Everybody knows how much babies sleep, and how little old people do. When people are tired out, or weakened by a disease they need more sleep to restore their lost strength.

In speaking of conditions conducive to sleep, let us first of all note the decrease of external stimuli. A person making ready for sleep does all he can to mitigate the effects of various factors that prevent sleep; he makes himself a convenient bed, puts out the light, strives for quiet, etc. Many birds go to sleep with their heads under their wings, while some animals seek for a secluded, quiet nook, where nothing can disturb them.

The necessity of decreasing external stimulation to produce sleep was also confirmed by various experiments on animals and by clinical observations. Thus, in the experiments conducted by V. Galkin on dogs that had been subjected to a simultaneous cutting of the olfactory, optic and auditory nerves sleep was observed for twenty-three and a half hours a day. Analogous, albeit somewhat altered, experiments were carried out by I. Nevsky; this

investigator observed the onset of sleep in animals and birds after he had excluded various sense organs by covering their eyes with cloth impenetrable to light, plugging their ears, etc.

The importance for the onset of sleep of decreasing the influx of external stimulations was also observed on patients in whom the activity of many sense organs was excluded in connection with their disease. Thus the German physician Strümpell had under his observation a boy patient blind in one eye and deaf in one ear; moreover, the boy had entirely lost skin sensitivity. When this patient's good eye was closed and his good ear plugged he would go fast to sleep within two or three minutes. Professor Pavlov also described a patient who had suffered a brain injury; after this injury the only sense organs that connected him with the outer world were one ear and one eye. The closing of these uninjured organs led to immediate sleep. And before Pavlov, Sechenov wrote that a complete loss of perception by the sense organs should correspond to deep sleep without dreams. Sechenov, too, described a certain female patient of whom he had been told by the prominent Russian physician S. Botkin with whom he was closely associated. The disease of this patient had involved all her organs of sense, except tactile and muscular feeling in one of her hands. As witnessed by the hospital staff, this patient spent all her time in sleep. Communication with other people was effected in the following manner: a pillow was placed on her abdomen, and the doctor or nurse would take the hand that had retained sensitivity and guide it, tracing on the pillow the questions to which an answer was desired. She would answer in words. The patient spoke with Botkin in the same manner.

How is this phenomenon to be explained from Pavlov's viewpoint of sleep being diffused inhibition? Pavlov himself defined the sleep that sets in in such cases as passive sleep. The decreased influx of stimuli to the brain

leads to a weakening of the process of excitation, and the latter is replaced by inhibition that easily diffuses over the cerebral cortex.

However, although the exclusion of external stimuli is highly important for the onset of sleep, undue weight should not be attached to this factor. People are able to and do go to sleep in noisy and brightly-lighted surroundings, depending on their requirements in sleep and their habits.

It is a well-known fact that during the last war soldiers would fall asleep, if conditions permitted, during shelling and bombing attacks, so exhausted were they and so long deprived of sleep. If a person is very sleepy he may fall asleep in the most uncomfortable attitude, sitting or standing, and in certain instances even while walking; thus soldiers sleep on the march, cavalrymen on their horses' backs. An interesting fact was communicated by the famous arctic explorer Fridtjof Nansen. He and his comrades often fell asleep during long ski runs.

One of the conditions promoting sleep is a monotonous, continuous type of stimulation. Everybody knows how conducive to sleep are the monotonous patter of rain, the rumble of a moving train's wheels, or the low and rhythmic swishing of the waves at the seashore. All lullabies are usually of a monotonous, plaintive, lulling nature. According to Pavlov, the soporific effect of monotonous, rhythmic, repeated stimulations is due to a prolonged excitation of one and the same brain cells, leading to a formation in them of protective inhibition that is then diffused over all the higher sections of the brain, thus producing sleep.

An important factor conducive to sleep is its periodic regularity. One and the same order of things, surroundings, and precise time of going to bed are particularly important for a rapid onset of sleep. Pavlov wrote that a strict order in the periods of waking and sleeping, an established rhythm of life, may increase the urgency of

sleep without sufficient fatigue of the cortical cells. For individuals who sleep badly these conditions may even be of a decisive nature in producing sleep. Some people, for instance, notwithstanding an intense desire for sleep, cannot fall asleep if their bedtime routine is in any way disrupted.

All these facts clearly point to the conditioned reflex nature of the production of sleep in response to an irritation that is constantly combined with it. Examples of this are various sleeping habits formed in connection with conditions and occupations. Thus, inhabitants of large cities become accustomed to sleeping to the accompaniment of street noises, travelling salesmen sleep just as well in a train as at home. Of particular importance in the onset of sleep is the conditioned time-reflex. For instance, when people move from one part of the country to another distant part, they are for some time sleepy in the new place at the time it would have been night at home, and not according to local time, although the entire surroundings (daylight, work) are not favourable for sleep. However, an individual with a healthy, well-balanced and sufficiently adjustable nervous system easily accustoms himself to sleeping in strange conditions. Such people can sleep soundly in unusual surroundings and in great discomfort, on a hard bed, in a bright light, and so on.

THERAPY BY PROLONGED SLEEP

The teachings of Ivan Pavlov on sleep as protective and restorative inhibition naturally put forth the question of the role of sleep as a curative agent for various diseases. The experience of everyday life confirms this role of sleep at every step. Let us recall how very important sleep is for severely sick people. We have already noted that a symptom of a disease having passed its critical moment and taken a turn for the better is the onset

of a deep and long sleep. Finally, everybody knows how much people convalescing from a protracted illness must sleep to regain their health and vigour.

Treatment by prolonged sleep has become highly popular in Soviet medicine. It was first applied in clinical psychiatrics in the treatment of one of the most widespread of mental diseases, the schizophrenic reaction or schizophrenia.

In order to gain a better understanding of the principle of the treatment of this type of insanity by prolonged sleep it is necessary to acquaint the reader briefly with Pavlov's views on the physiological principles of the schizophrenic reaction. Back in 1918 Pavlov regularly visited a mental hospital in order to observe the inmates. His attention was attracted by a male patient suffering from the so-called catatonic form of schizophrenic reaction, characterised chiefly by alterations in the motor sphere. Here is Pavlov's own description of this patient: "A man aged sixty. He spent twenty-two years of his life in the hospital, lying like a living corpse without making the least voluntary motion, absolutely speechless; he was very untidy, and had to be fed through a tube. During the last few years, as he approached sixty, he began more and more to make voluntary movements. At present he gets out of bed without help, goes to the lavatory, talks freely and quite reasonably, and often eats without assistance. Referring to his former state, he declares that he understood everything around him, but experienced such an extreme and insuperable heaviness in his muscles that he could hardly breathe. This was the reason why he neither moved, ate, nor spoke."

Observing this patient and other patients with the same form of schizophrenic reaction Pavlov arrived at the conclusion that the basis of their affliction was a prolonged inhibition of the regions of the brain that determine normal muscular tone, govern motor activity and speech. In other forms of the disease this inhibition involves corti-

cal areas connected with other nervous and mental functions.

But why do the nerve cells in the brains of schizophrenics pass into a state of chronic inhibition? Because, Pavlov says, such patients have weak nervous systems, weak cortical cells that are easily fatigued; for these cells even normal nerve excitation is excessive. And as we have already seen above, in cases of overexertion protective inhibition appears in order to protect the nerve cells from destruction; protective inhibition guards these weak and easily exhausted cells against the effects of external stimuli. This leads to the conclusion that schizophrenic cases manifesting protective inhibition should be treated by supporting and deepening this inhibition by prolonged sleep.

The treatment of the insane with prolonged sleep was commenced, at Pavlov's suggestion, in a mental clinic under the auspices of his laboratory, in 1936. The treatment was carried out under the supervision of Dr. A. Ivanov-Smolensky. The soporific agents employed evoked a deep and sound sleep that continued, under favourable external conditions, for six, eight or even ten days; this sleep was entirely similar to natural physiologic sleep. In a number of cases durating no longer than one year a clearly pronounced improvement was observed.

Approximately the same results were obtained by M. Sereisky, V. Protopopov and V. Gilyarovsky, and a number of other Soviet psychiatrists who treated the schizophrenic reaction with prolonged sleep.

A number of other mental conditions have likewise been successfully treated with prolonged sleep. Thus, for instance, Professor Y. Popov applied this method in the treatment of delirium tremens.

During the years of the Great Patriotic War sleep treatment was found to be beneficial in other fields of medicine. In 1942 Dr. Asratyan proposed a new method for treating various severe after-effects of battle wounds

with prolonged sleep. The principle of this method lay in the following: in the evening the patients were given a dose of specially selected soporifics that evoked a ten- to twelve-hour sleep having nothing in common with narcosis and being very close to natural physiologic sleep. In the daytime these patients were awake. The results of the treatment were favourable. A. Dolin, A. Ivanov-Smolensky, S. Kaminsky and others likewise employed this method of treatment during the war for patients with traumatic injuries of the nervous system.

In 1943 F. Andreyev, proceeding from the practice of applying prolonged sleep in the treatment of mental and nervous diseases and battle wounds, introduced this method for the treatment of gastric and duodenal ulcers.

Prolonged sleep has been a successful agent in the treatment of the hypertensive disease. As we know, a stable high blood pressure is characteristic of this disease. Hypertension does not ordinarily develop all at once. The stable high level of the blood pressure is preceded by temporary jumps, fluctuations from normal to abnormally high. Prolonged sleep in combination with other agents proved to be effective in the initial phase of the disease.

Prolonged sleep therapy for various internal diseases was scientifically substantiated in the statements of Pavlov on the interrelationships of the cerebral cortex and the visceral organs.

According to Pavlov the cortex of the cerebral hemispheres is the highest section of the brain that governs all the phenomena occurring in the body. K. Bykov, a pupil of Pavlov's, developed this point extensively. He proved by a number of brilliant experiments that the cerebral cortex provides the co-ordination of the vital activity of all the organs by means of nerve impulses emerging from it. The cortex also regulates all the vital processes of the organism: nutrition, respiration, metabolism,

control of body temperature, etc. However, M. Petrova (one of Pavlov's closest associates) has shown in experiments with dogs that if the cerebral cortex be weakened by an overexertion of its fundamental excitatory and inhibitory processes, or by overtaxing the mobility of these processes, thereby arranging their collision, then, owing to the regulating activity of the cortex, various morbid changes may occur in the internal organs. Now prolonged sleep, providing as it does complete rest for the cortex, restoring the energy of its nerve cells and improving cortical regulation of the functions of the internal organs, has a favourable effect on these organs.

DISORDERS OF SLEEP. MORBID SLEEP

People afflicted by a morbid disorder of sleep naturally become uneasy about their condition, as such disturbances affect general health and working capacities. Morbid disorders of sleep are manifested by either increased drowsiness, or by insomnia (sleeplessness). Both conditions are predominantly the result of overwork, of irregular sleep, or of sleeping in unfavourable conditions. Let us dwell shortly on these disorders of sleep.

Drowsiness resulting from a regular shortage of sleep cannot be looked upon as a morbid condition. This is but the normal reaction of a healthy body striving to satisfy its vital needs. Just as there are no other means of overcoming hunger or thirst than by satisfying them, so increased drowsiness of this type can only be eliminated by taking a good long sleep, and after that by sleeping as much as the body craves.

However, in a number of cases a person may have slept an adequate number of hours, may even feel that he has had enough sleep, and yet be sleepy all the time, his working capacity becoming very low. Sometimes the condition appears at the very outset of the workday, when

there would seem to be no "lawful" reasons for it. For example, take the drowsiness observed in college students during the early morning lectures. In some instances such a sudden craving for sleep may be explained by the fact that in certain individuals the transition from sleep to the waking state and activity occurs slowly, with delay; these people need a certain period of adaptation, of adjustment to work. In these cases drowsiness must be overcome by an effort of will and by regular physical exercises in the morning to disperse the remnants of sleep and stimulate the nervous system.

However, in some cases continuous drowsiness is observed as the result of exhaustion. This type of sleepiness is of a protective nature, as it blocks the fatiguing activity of the nervous system. It can only be overcome by dealing with its basic cause, that is, with overfatigue. A temporary rest is needed, and a better regimen of work. It is also expedient to sleep longer hours, and to take a nap, if possible, in the daytime.

Another disturbance of sleep is insomnia, sleeplessness; this is an often observed condition that is tolerated with greater difficulty than drowsiness is. The word "sleeplessness" must not be understood literally as a complete loss of sleep when a person never gets enough sleep notwithstanding his urgent need of it. No, insomnia may appear in several forms, the principal ones being disorder of the falling-asleep phase, light, restless, broken sleep and early waking. The disturbance of the phase of falling asleep is manifested by a person not being able to go to sleep for a long time, notwithstanding all efforts. He thinks all the time of sleeping, turns from side to side, asks himself why he cannot fall asleep, and still lies awake. And as a rule he imagines the unpleasant sensations of tomorrow, when he will have to get up without having had enough sleep, thinks of how he will go around all day in a dull, gloomy and irritative mood, of how he will not be able to do his work, and so forth.

Alexander Pushkin has a poem called "Remembrance", in which he presents a vivid picture of the agony of insomnia:

... For me, when night has fallen, through the silence drag
Long hours of wakefulness and pain;
With keener fang, when all the body's movements flag,
My heart the serpent gnaws again;
My fancy seethes with dreams; my mind, that sorrow daze,
An overheavy burden holds;
Then Memory her scroll before my sleepless gaze,
Adding no single word, unfolds....

Disorders of this phase of sleep may be caused by the presence in the cerebral cortex of a point of excitation unaffected by inhibition that prevents the diffusion of the latter over all the higher sections of the brain that constitutes sleep. Such a point of excitation can be of various origin. It may be the result of overexcitation before going to bed, or of deep impressions, strong emotions, intensive mental work. This pertains in particular to elderly people in whom inhibitory processes weaken with age, and the mobility of nerve processes decrease. Then, too, a person may not be able to fall asleep because of emotions associated with anticipation, with worry, with anxiety about oversleeping a certain hour.

People suffering from insomnia often worry about possible grave after-effects, about the formation of nervous or mental diseases; they are afraid that sleeplessness may make invalids of them. However, although insomnia is a serious and unpleasant disorder, still such misgivings are unfounded. Moreover, people affected with insomnia often exaggerate its harmful effects. They frequently cannot make a correct estimation of the time they spend sleepless, unintentionally imagining it to be greater than it really is: minutes spent awake seem hours. Moreover, it must be taken into account that a heightened interest

and anxiety over sleep is in itself a disturbing reason that prevents a person from falling asleep.

When the mind is focussed on thoughts about quickly falling asleep this creates a site of excitation in the brain that is an obstacle to sleep. Thus, excessive worry over falling asleep may prevent sleep.

"One should not chase sleep," wrote the Swiss scientist Dubois. "One has only to begin the hunt for sleep to fly away faster than a bird." And then too, one must remember that when one lies in an easy pose, in silence and darkness, effortless and relaxed, this is already rest for the nervous system.

Insomnia manifested as troubled, light, frequently broken sleep may be of two types. In some cases frequent breaks in sleep are due to its lightness, when a person is awakened by even the slightest external irritants. On the other hand, sleep disturbances may not be due to external factors, but may be the result of the instability of the inhibition of sleep. Naturally, in the first case it is necessary to provide complete quiet for the patient's sleep, while in the second case attention should be directed toward eliminating everything that stimulates the nervous system before sleep. Insomnia in the form of early awakening is observed less frequently. In older people it may be explained by the need for sleep diminishing with age, and should not be looked upon as a morbid condition. Sometimes early awakening may be an old habit connected with a former routine of life. And when conditions have changed, even though a person may be going to bed at a later hour than previously, he persistently wakes up at the usual early hour, and cannot overcome this habit. If it is not possible to establish an earlier hour for going to bed, that is, to re-establish the old order and hours of sleep, then a doctor's advice should be sought. Sleeping drugs taken for a day or two are usually an aid in overcoming habit, providing the necessary amount of sleep so that one wakes up at the right time. But it must

be stressed that sleeping pills should never be taken without a doctor's prescription.

The troubled and restless slumber of "neurotic" individuals is often associated with bad dreams they have and worry over. These dreams may completely reflect unpleasant emotions experienced in the waking state, or they may be of an erotic nature, accompanied by sexual desire, or again they may be "haunting" dreams that are repeated night after night in one and the same form. Nightmares are particularly depressing dreams in which a person sees all manner of horrors, murder, fire; they cause an agonising sense of fear and the sleeper wakes up trembling, in a cold sweat.

There is no need to speak of the special agents employed in the treatment of disturbances of sleep which are prescribed by a doctor in every individual case. However, we consider it necessary to stress the particular importance of a strict regimen for normalising sleep. This is conducive to its rapid and easy onset.

We have examined various "neurotic" disorders of sleep. It is necessary to dwell shortly on morbid forms defined as "partial, disconnected", or "dissociated" sleep. During normal physiologic sleep, as we have already seen, motor activity and speech are absent, the muscles loosen up, the sleeper is estranged from the outer world, he is unaware of what goes on around him, lies passive and immobile.

In discussing hypnosis we established that there might be partial sleep with "alert sentry-posts" in the brain, with alternating points of excitation and inhibition on a background of generalised inhibition of the brain.

The morbid disorders of sleep we are now speaking of may be defined as a distortion of sleep in which phenomena of partial, dissociated sleep are observed instead of complete sleep. This morbid type of sleep may appear in the most varying forms.

Somnambulism, or sleepwalking, is a form in which the individual walks in his sleep, and without being conscious of it, automatically does something: gets out of bed with his eyes open or half-shut, moves slowly with a cautious, feeling step, often manifesting a peculiar agility, climbing to the roof, up a window ledge, into a tree. Then he returns to his room, gets into bed and continues sleeping normally. Sleepwalking may cover a period of time ranging from several minutes to half an hour. In the morning the sleepwalker (somnambulist) does not remember any of the things he did at night.

The physiological mechanism of sleepwalking is not difficult to explain. The cortex of the cerebral hemispheres of somnambulists is inhibited (as it should be), excepting for one morbid area that controls motor activity, ambulation; thus automatic walking during sleep is observed. The nimbleness displayed, particularly in dangerous places, is due to the absence of any awareness of danger, and to the automatic, involuntary nature of the motions; such motions are always more precise and assured. Sleepwalking is not a frequent complaint. It denotes a disorder of the nervous system that usually may be traced back to childhood. Such cases should always be treated by a neurologist.

Somniloquism, or talking in one's sleep, is encountered much more frequently than somnambulism is. Usually the speech of a sleeping person is not clear, and it is very short, just a few mumbled words. "Sleeptalking" is a sign of the incomplete inhibition of the speech centre in the brain. Observations have proved that it is usually a harmless condition. However, if it takes on a severe aspect, the sleeper talking the night through, retelling the events of the past day, then it becomes necessary to consult a doctor.

A morbid form of sleep that often awakens particular interest and evokes erroneous interpretations is so-called lethargic sleep, or lethargy. The term itself calls for a

more precise definition. It is often employed to designate the most diverse morbid conditions. The immobility and stupor associated with the catatonic type of schizophrenic reaction is frequently mistakenly called lethargy. The prolonged somnolence of epidemic encephalitis patients is likewise incorrectly termed "lethargic".

Actually lethargy is a condition observed in severe cases of hysteria. It is characterised, first of all, by such a sharp decrease in all vital processes that it sometimes takes on the seeming aspect of death. Lethargic stupor may continue for an unusually long time, and it is impossible to awaken the patient by any ordinary means.

Lethargic sleep is encountered very rarely. While in this condition the patient's eyes are closed, and only a slight tremor of the eyelids is infrequently noticed; muscular tone is absent and no responses to stimulations of the skin are evoked in the flabby muscles; respiration and cardiac activity are sometimes sharply lowered and weakened. In prolonged lethargic conditions the ingestion of food and the natural functions of the body occur more or less normally.

HYGIENE OF SLEEP

The first question that arises when speaking of schedules for sleep is just how many hours does a person need in order to maintain his health? It is not so easy to answer this question, as in many instances the time needed for sleep may be shortened by its soundness, and, besides, the requirements of different people in sleep differ significantly. Age, habits, conditions of life are all vital factors. The most generalised rule that can be formulated is that the older a person becomes the less sleep he needs. Newborn infants lead a predominantly somnolent life, sleeping up to 22 hours a day, while aged people sleep very little, five to six hours of light sleep often being sufficient. Adults usually sleep seven to eight hours;

however, deviations from this norm either way have no harmful effect on health. It is known, for instance, that Bekhterev slept no more than five or six hours a day and retained both health and a high capacity for work.

It is much easier to determine sleep norms for children. Between the ages of two and four years children should get no less than 15-16 hours of sleep a day, from four to seven they need 12 hours, from seven to twelve 10 hours, and between the ages of twelve to sixteen they need eight and a half to nine hours of sleep daily.

Besides sleeping at night children younger than four-five years old must also sleep for several hours during the day. In childhood the nervous system is very sensitive and delicate, children become tired easily and therefore need more sleep than adults do. Moreover, besides resting and restoring the strength of the nerve cells, sleep is the time when children grow. Well-organised and sufficient sleep is conducive to better growth and development.

There are a number of professions that necessitate work at night and sleep in the daytime. Thus naturally arises the question of whether or not this may be injurious to health. Medical science has a quite definite answer to it. Medical observations of representatives of various professions who have to work at night (railroad employees, the medical profession, and factory workers periodically engaged on the night shift) have shown that the replacement of night sleep by daytime sleep does not affect the health in these cases. However, it is necessary to allot a sufficient number of hours for sleep, and to create conditions favourable for sound sleep in the daytime.

However, this is true only for adults. It is harmful to children for their normal night sleep to be replaced by sleep during the day, and children must never be allowed to go to bed late. Children younger than nine years should be put to bed between eight and nine o'clock at night.

As we have already said, children younger than four-five years (if possible, even older children) must take a nap during the daytime. It is also good for elderly people who sleep poorly at night or wake up too early to sleep for an hour or two during the daytime; however, people with a tendency to stoutness should sleep *before* the mid-day meal, not after. It is very important to train oneself to go to bed and get up at a definite time. This is conducive to a rapid onset of sleep, and to sounder sleep. If a person has to work at night sometimes, thus making impossible a stable schedule for sleeping and rising, it is still possible, and very necessary, to institute a definite, albeit sliding, schedule and routine of sleep.

To get the full value of one's sleep, and particularly to train oneself to go to sleep easily and quickly it is useful to follow a number of routine bedtime rules. All serious mental work should be ceased an hour or an hour and a half before retiring for the night, and some light chore not calling for particular concentration, or complete rest, is recommended instead. People who have difficulty in falling asleep should avoid anything that might excite them in the evening. It is not advisable for such individuals to indulge in conversations of an emotional nature before going to bed, or to go to late cinema shows or dramatic theatrical performances, or to read absorbing or exciting literature. Observance of these rules is obligatory for children. They should finish doing their lessons and cease all manner of noisy games an hour and a half or even two hours before bedtime. Little children should not be told bedtime stories that might frighten or excite them.

It is not advisable to go to bed right after supper. The last meal should be taken an hour and a half or two hours before sleep. This meal should never be too abundant, consisting of easily digested food with no high seasoning. No stimulating drinks, including strong tea and coffee, should be taken at night (particularly by children).

Before retiring for the night the face, hands, and feet should be washed, the teeth brushed, cleanness of night-clothes and bedclothes checked. Warm ablutions (washing, baths, foot-baths) are conducive to the rapid onset of a healthy sleep, while cold water does just the opposite, stimulating the nervous system and preventing sleep; therefore cold water showers or rub-downs should be taken in the morning, not at night. No physical exercises are permissible before sleep; however, a short, untiring walk is very beneficial.

It is a harmful habit for children to become accustomed to falling asleep only with the aid of some auxiliary means (rocking, singing, etc.). It is also bad when parents start walking around on tiptoe after putting their children to bed. This leads to the parents being forced to limit their activities significantly; they cannot lead a normal life after their children have gone to bed. And as a result, the child develops a habit of sleeping very lightly and restlessly. One should know that the sound and calm sleep of babies is not disturbed by any ordinary external irritants. As a rule, they are awakened only by hunger or wet diapers. It is highly important for children to become accustomed to sleeping in ordinary surroundings, when their parents are at home sitting at the table, having supper, working or talking. However, here, as in everything else, a sense of proportion should be observed.

Fresh air and proper temperature in the sleeping premises are very important. Before sleep the room should be well aired. The beneficial effect of sleeping in the fresh air is a well-known fact confirmed by observations of the forest schools for tuberculous children and sanatoriums instituted for TB treatment. It is very good to accustom oneself to sleep with an open window (or transom) throughout the year. The usually recommended room temperature is 17-18°C, but during the night it may be lower (14-15°C). One needs only to cover up warmly. Stuffy air

and overwarming are positively harmul; during sleep the body perspires freely, and the perspiration vapourises from the skin's surface. In the absence of a supply of fresh air the room becomes stuffy and sour-smelling. The inhalation of such air during sleep makes people wake up with headaches.

Human beings spend approximately one-third of their life asleep, therefore bed hygiene is a serious matter. The bed should stand in the best place of the room, where there is a sufficient current of fresh air, and that is well-lighted in the daytime. The bed should be comfortable, not too narrow nor too short.

People assume the most various attitudes in their sleep. Some lie on their backs, stretching out their legs or folding them, placing their hands under their heads or stretched out along their sides, often they curl up into a huddle. Still others sleep on their stomachs. Adults need no particular restrictions in selecting the pose that suits them best. But it is harmful for children to sleep on their stomachs, face down. Such a pose interferes with proper breathing. Infants and young children should be turned from one side to the other. If a small child sleeps on its back it may choke on food that is sometimes regurgitated during sleep. Children should be trained to keep their hands outside the blankets during sleep. Elderly people are not advised to sleep on their left side, as this often interferes with cardiac activity and evokes unpleasant sensations and nightmares. Many people sleep well on low pillows, but most sleep better on a high one. Often insomnia may be overcome simply by changing the position of the head. A higher and more comfortable pillow may help better than any soporific agent. During sleep the head should always remain uncovered, while the feet should be covered warmly, as this facilitates sound sleep.

It is unhealthy to remain lying in bed after waking up in the morning; this is especially true for children, as it weakens the body and the nervous system, lowers their

will-power. One should get out of bed immediately upon waking up, do physical exercises in front of an open window, and then take a shower or sponge bath.

Morning ablutions are recommended to be done with cool water. After a good night's sleep one should start work directly.

Working capacity is particularly high in the morning. One should always bear in mind that while sound sleep is a guarantee of good health, good, satisfying work is an important condition conducive to sound, healthy sleep.

TO THE READER

The Foreign Languages Publishing House would be glad to have your opinion of the translation and design of this book.

Please send your suggestions to 21, Zubovsky Boulevard, Moscow, U.S.S.R.

Printed in the Union of Soviet Socialist Republics

Л. РОХЛИН

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